
Reconnaissance Report
Misquamicut Beach
Westerly, Rhode Island

Shore Protection and Flood Damage Reduction

January 1994



**US Army Corps
of Engineers**
New England Division

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
<small>Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503.</small>				
1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE January 1994	3. REPORT TYPE AND DATES COVERED Reconnaissance Report		
4. TITLE AND SUBTITLE Shore Protection and Flood Damage Reduction Misquamicut Beach Westerly, Rhode Island		5. FUNDING NUMBERS Section 103 1962 Rivers and Harbors Act		
6. AUTHOR(S) U.S. Army Corps of Engineers New England Division				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) U.S. Army Corps of Engineers, New England Division 424 Trapelo Road Waltham, Massachusetts 02254-9149		8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) Town of Westerly, Rhode Island		10. SPONSORING / MONITORING AGENCY REPORT NUMBER		
11. SUPPLEMENTARY NOTES <i>Center of the study</i> Misquamicut Beach area is in Westerly, Rhode Island				
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release Distribution is unlimited		12b. DISTRIBUTION CODE		
13. ABSTRACT (Maximum 200 words) This reconnaissance scope study was conducted under the special continuing authority contained in Section 103 of the 1962 Rivers and Harbors Act, as amended. It investigated alternative measures to reduce recurring storm damages and coastal flooding to the Misquamicut Beach area in the town of Westerly, Rhode Island. Storm damages and flooding occurred most recently in Dec. 1992 and Mar. 1993, when storms swept across Block Island Sound. It is estimated that these two events together caused over \$550,000 in damages to the shorefront and adjacent neighborhoods. This report describes the study process used to formulate and evaluate alternative solutions designed to reduce shore damage and backshore flooding. The results of a reconnaissance scope investigation of project effectiveness, costs, and environmental acceptability for various flood protection alternatives are presented. No economically feasible solution was found.				
14. SUBJECT TERMS storms; flooding; berms; floodways; Misquamicut Beach; Block Island Sound		15. NUMBER OF PAGES 131		
		16. PRICE CODE		
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT	

GENERAL INSTRUCTIONS FOR COMPLETING SF 298

The Report Documentation Page (RDP) is used in announcing and cataloging reports. It is important that this information be consistent with the rest of the report, particularly the cover and title page. Instructions for filling in each block of the form follow. It is important to stay within the lines to meet optical scanning requirements.

Block 1. Agency Use Only (Leave blank).

Block 2. Report Date. Full publication date including day, month, and year, if available (e.g. 1 Jan 88). Must cite at least the year.

Block 3. Type of Report and Dates Covered. State whether report is interim, final, etc. If applicable, enter inclusive report dates (e.g. 10 Jun 87 - 30 Jun 88).

Block 4. Title and Subtitle. A title is taken from the part of the report that provides the most meaningful and complete information. When a report is prepared in more than one volume, repeat the primary title, add volume number, and include subtitle for the specific volume. On classified documents enter the title classification in parentheses.

Block 5. Funding Numbers. To include contract and grant numbers; may include program element number(s), project number(s), task number(s), and work unit number(s). Use the following labels:

C - Contract	PR - Project
G - Grant	TA - Task
PE - Program Element	WU - Work Unit Accession No.

Block 6. Author(s). Name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. If editor or compiler, this should follow the name(s).

Block 7. Performing Organization Name(s) and Address(es). Self-explanatory.

Block 8. Performing Organization Report Number. Enter the unique alphanumeric report number(s) assigned by the organization performing the report.

Block 9. Sponsoring/Monitoring Agency Name(s) and Address(es). Self-explanatory.

Block 10. Sponsoring/Monitoring Agency Report Number. (If known)

Block 11. Supplementary Notes. Enter information not included elsewhere such as: Prepared in cooperation with...; Trans. of...; To be published in.... When a report is revised, include a statement whether the new report supersedes or supplements the older report.

Block 12a. Distribution/Availability Statement. Denotes public availability or limitations. Cite any availability to the public. Enter additional limitations or special markings in all capitals (e.g. NOFORN, REL, ITAR).

DOD - See DoDD 5230.24, "Distribution Statements on Technical Documents."

DOE - See authorities.

NASA - See Handbook NHB 2200.2.

NTIS - Leave blank.

Block 12b. Distribution Code.

DOD - Leave blank.

DOE - Enter DOE distribution categories from the Standard Distribution for Unclassified Scientific and Technical Reports.

NASA - Leave blank.

NTIS - Leave blank.

Block 13. Abstract. Include a brief (Maximum 200 words) factual summary of the most significant information contained in the report.

Block 14. Subject Terms. Keywords or phrases identifying major subjects in the report.

Block 15. Number of Pages. Enter the total number of pages.

Block 16. Price Code. Enter appropriate price code (NTIS only).

Blocks 17. - 19. Security Classifications. Self-explanatory. Enter U.S. Security Classification in accordance with U.S. Security Regulations (i.e., UNCLASSIFIED). If form contains classified information, stamp classification on the top and bottom of the page.

Block 20. Limitation of Abstract. This block must be completed to assign a limitation to the abstract. Enter either UL (unlimited) or SAR (same as report). An entry in this block is necessary if the abstract is to be limited. If blank, the abstract is assumed to be unlimited.

Misquamicut Beach
Westerly, Rhode Island
Reconnaissance Report

U. S. ARMY CORPS OF ENGINEERS
NEW ENGLAND DIVISION

JANUARY 1994

EXECUTIVE SUMMARY

This reconnaissance scope study was conducted under the special continuing authority contained in Section 103 of the 1962 Rivers and Harbors Act, as amended. It investigated alternative measures to reduce recurring storm damages and coastal flooding to the Misquamicut Beach area in the town of Westerly, Rhode Island. Storm damages and flooding occurred most recently in December 1992 and March 1993, when storms swept across Block Island Sound.

It is estimated that these two events together caused over \$550,000 in damages to the shorefront and adjacent neighborhoods. This report describes the study process used to formulate and evaluate the various flood protection alternatives considered for the study area. No economically feasible solution was found, however, one of the solutions under consideration was found to have economic justification just below unity.

Misquamicut Beach is part of a narrow, sandy barrier beach that extends from headlands at Watch Hill Point to Weekapaug Point along Rhode Island's south shore that faces Block Island Sound. The study area consists of approximately 16,500 feet of shorefront and adjacent backshore areas between Little Maschaug Pond on the west and Weekapaug Breachway on the east. Much of the backshore area is occupied by Winnapaug Pond, a tidewater pond linked to the ocean by the Weekapaug Breachway. The beach faces the considerable energy of waves generated within Block Island Sound. Commercial and residential development, land maintained for recreational use and parking areas separate the beach from Atlantic Avenue, the road that parallels the beach. With its proximity to the urban areas of both Rhode Island and southeastern Connecticut, the study area is a very popular summer resort. The area's population and use of the beach and adjacent backshore areas increases dramatically in the summer. See Location Map, Plate 1, and Study Area map, Plate 2 in this report.

This report describes the problem and its effects on Misquamicut Beach and discusses several alternative solutions designed to reduce shore damage and backshore flooding. The protective plan identified in this Reconnaissance Report provides for the construction of a 4000 foot beach berm at elevation 17.9 feet above mean low water and a pair of floodwalls that would protect the area behind the berm from high water on its flanks. A pump station would be provided for removal of interior drainage. The berm extends seaward from the line of existing development or duneline, with a fronting slope of 1 vertical to 15 horizontal, extending downward until it intersects the existing ground. It is anticipated that the beach fill would be obtained from several land-based borrow

sites within a 30 mile radius of the beach, and would have a median grain size ranging between that of native material samples taken at the mid-tide and high tide levels. The larger grain size will increase the stability of the new beach berm against erosion forces.

Preliminary field investigations, as well as initial coordination with Federal, State and local resource agencies, have not revealed any outstanding or unresolvable environmental issues or concerns associated with the plan.

The total scheduled implementation costs of the plan put forward in this report is \$18,675,000 and the total annual charges, consisting of interest and amortization of the first costs, the cost of periodic sand nourishment, based on historical records and the cost of the project's annual operation and maintenance is \$1,724,000. Average annual benefits from damages prevented are estimated at \$1,580,000. The benefit to cost ratio is 0.92.

The total cost of a cost-shared feasibility study is estimated to be \$540,000.

The overall financed cost of the project is summarized as follows:

	<u>Federal</u>	<u>Non-Federal</u>	<u>Total</u>
Scheduled Construction Cost	\$12,139,000	\$6,536,000	\$18,675,000
Unscheduled Construction Cost	<u>2,155,000</u>	<u>1,160,000</u>	<u>3,315,000</u>
(Nourishment)			
TOTALS	\$14,294,000	\$7,696,000	\$21,990,000

The reconnaissance study described in this report demonstrates that the project is environmentally and technically feasible. Economic feasibility is close to unity but negative. The total cost of the project greatly exceeds \$ 2 million, which is the statutory limitation under Section 103 of our Continuing Authorities Program. Due to the high cost, it is likely that an open Congressional resolution would be employed by the Rhode Island Congressional Delegation should they wish to pursue a project. The Division Engineer, New England Division, recommends termination of further Corps activities on this project with the publication and distribution of this document.

MISQUAMICUT BEACH
WESTERLY, RHODE ISLAND
SECTION 103
RECONNAISSANCE REPORT

TABLE OF CONTENTS

<u>ITEM</u>	<u>PAGE NUMBER</u>
INTRODUCTION	1
AUTHORITY	2
STUDY PURPOSE AND SCOPE	2
STUDY PARTICIPANTS AND COORDINATION	2
PRIOR STUDIES AND REPORTS	3
EXISTING PROJECT	4
PHYSICAL SETTING	4
ENVIRONMENTAL SETTING AND RESOURCES	4
PROBLEM DEFINITION	5
PLANNING GUIDANCE	5
STATEMENT OF PROBLEM	
WITHOUT PROJECT CONDITION	6
SCREENING OF ALTERNATIVES	10
PLAN FORMULATION	16
ECONOMIC ANALYSIS	20
ENVIRONMENTAL CONCERNS	25
ENVIRONMENTAL FINDINGS	26
CONCLUSIONS	26
RECOMMENDATIONS	27
ACKNOWLEDGMENTS	28

TABLES

1	WIND GENERATED WAVES	8
2	EXISTING RUNUP CONDITIONS	9
3	COMPARISON OF ALTERNATIVE PLANS	18
4	TOP OF AVERAGE WAVE RUNUP ALONG THE PROPOSED PROTECTIVE BEACH	21
5	SUMMARY OF ANNUAL PROJECT BENEFITS	22
6	SUMMARY OF PROJECT COSTS	23

TABLE OF CONTENTS

(continued)

ITEM

FOLLOWS PAGE NUMBER

LIST OF PLATES

PLATE 1	LOCATION MAP	2
PLATE 2	STUDY AREA	2
PLATE 3	PHOTOGRAPHS	2
PLATE 4	PHOTOGRAPHS	2
PLATE 5	PHOTOGRAPHS	2

LIST OF FIGURES

FIGURE 1	LOCATIONS OF THE ELEMENTS OF VARIOUS ALTERNATIVE PLANS	12
FIGURE 2	TYPICAL WALL SECTION	12
FIGURE 3	TYPICAL DIKE SECTION	12
FIGURE 4	TIE - IN DIKE SECTION AT INLET CONTROL STRUCTURE	12
FIGURE 5	INLET CONTROL STRUCTURE	12
FIGURE 6	PROFILE OF TYPICAL BEACHFILL DESIGN	12

APPENDICES

A	HYDROLOGIC & HYDRAULIC ANALYSIS
B	ENVIRONMENTAL RECONNAISSANCE REPORT
C	ECONOMIC ANALYSIS
D	GEOTECHNICAL LOGS
E	PERTINENT CORRESPONDENCE

MISQUAMICUT BEACH
WESTERLY, RHODE ISLAND
SECTION 103
RECONNAISSANCE REPORT

INTRODUCTION

Misquamicut Beach is situated about two and one half miles east of the village of Watch Hill, and is wholly in the town of Westerly. The location of Misquamicut Beach is shown in Plate 1. The study area consists of 3 1/8 miles of shorefront and adjacent backshore areas between Little Maschaug Pond on the west and Weekapaug Breachway on the east. Much of the backshore area is occupied by Winnapaug Pond, a tidewater pond linked to the ocean by the Weekapaug Breachway. The study area limits are depicted in Plate 2.

With its proximity to the urban areas of Rhode Island and southeastern Connecticut, the Misquamicut area is a very popular summer resort. The area's population and use of the beach and adjacent backshore areas increases dramatically in the summer.

The study area is comprised of mixed commercial and residential structures located along the beachfront. A total of 162 shorefront properties exist along the beach, with about 3300 linear feet currently having public ownership and access. The study area also includes a number of affected residential and commercial structures located on the north side of Atlantic Avenue, the main road that parallels the shoreline. Residential enclaves north of Atlantic Avenue include homes on Breach Drive, Shore Gardens Road, and the Misquamicut neighborhood between Winnapaug Pond and Little Machaug Pond. Selected photographs from the study area are presented in Plates 3 through 5.

The study has focused on measures to reduce future damaging effects of wave and tidal action on the properties that line the Misquamicut shore and also to reduce backshore flooding during periods of wave overtopping. Two storms during the winter of 1992-93 caused a total of over \$550,000 in damages in the study area.

This Reconnaissance Report presents the results of the investigation that was conducted to determine the feasibility of providing local shore and flood protection to the Misquamicut area at the request of the Town of Westerly in their letter of December 22, 1992.

AUTHORITY

This report was prepared under the special continuing authority of Section 103 of the 1962 Rivers and Harbors Act, as amended, for the purposes of shore protection and flood damage reduction from coastal storms. The Army Corps of Engineers, New England Division (NED), performed the study at the request of the town of Westerly, Rhode Island. Coastal projects constructed under the Section 103 authority are cost shared between the Federal government and a non-Federal public sponsor, with the Federal share being 65 percent of the total, not to exceed \$2,000,000.

STUDY PURPOSE AND SCOPE

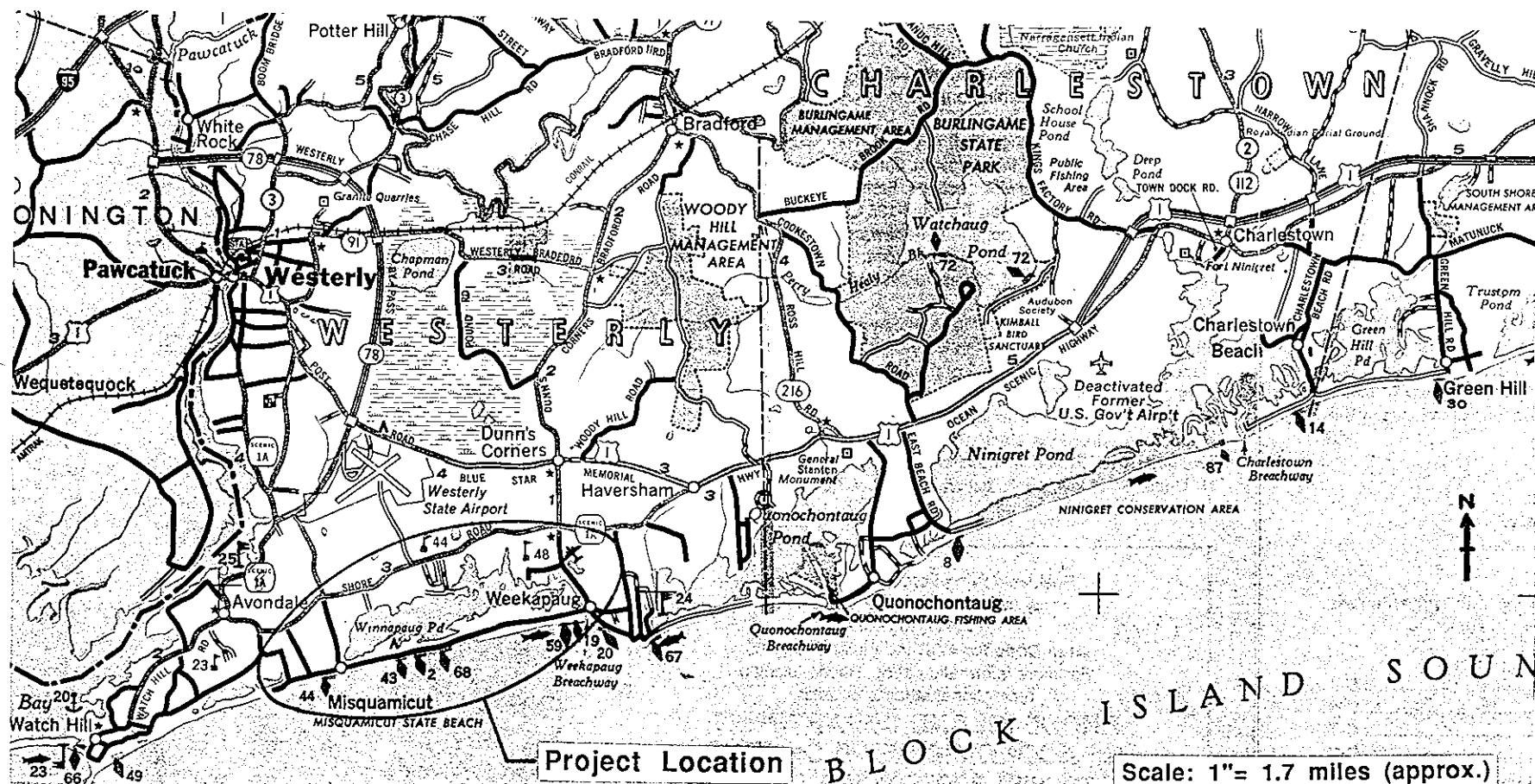
The purpose of this reconnaissance study is to determine whether further planning to alleviate the storm and flood damages in the study area merits Federal involvement.

Most past damages, especially in the recent past, have occurred to the exposed sand dunes and to beachfront structures. The continuing beach erosion has made shorefront properties more vulnerable to storms of a given magnitude than they would have been in years past. This study reexamines previous shore protection initiatives in this area, including elements of a previously authorized project from the early 1960's that was never built.

Damages that will occur in the study area if no project is constructed have been estimated, based on damage surveys and stage frequency curves prepared by NED. Several alternative plans were formulated to alleviate damages to the study area, and they were examined in sufficient detail to conduct a cost-benefit analysis. A review of environmental considerations within the study area and for the proposed alternatives was also performed.

STUDY PARTICIPANTS AND COORDINATION

An initial meeting and an inspection of the Misquamicut Beach area took place on March 16, 1993, when NED representatives met with local officials and other interested persons. Damage to structures as well as severe beach erosion from a recent winter storm was evident from the inspection.



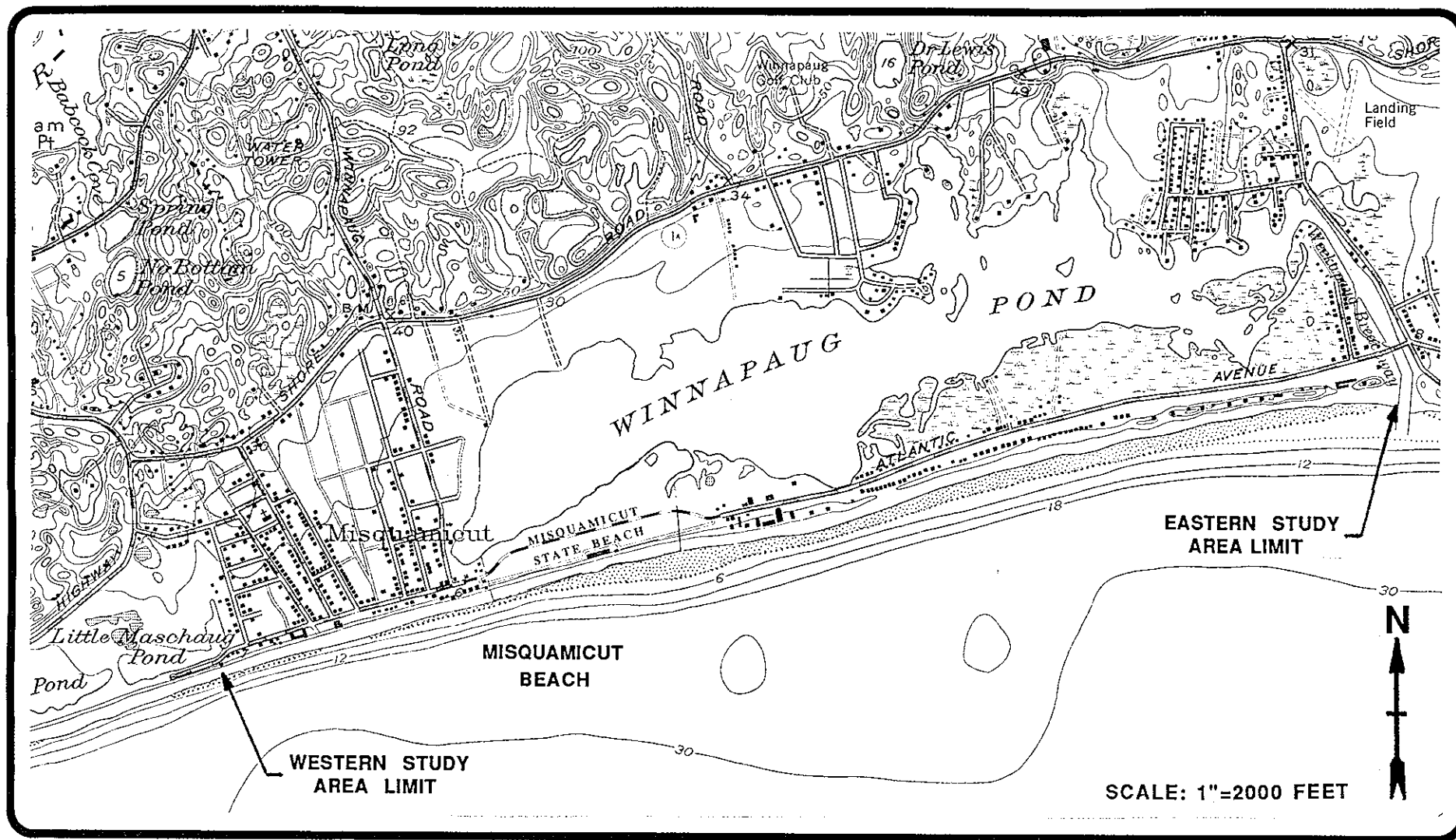
SHORE PROTECTION & FLOOD DAMAGE REDUCTION

LOCATION MAP

MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND



US Army Corps
of Engineers
New England Division



SHORE PROTECTION & FLOOD DAMAGE REDUCTION

STUDY AREA

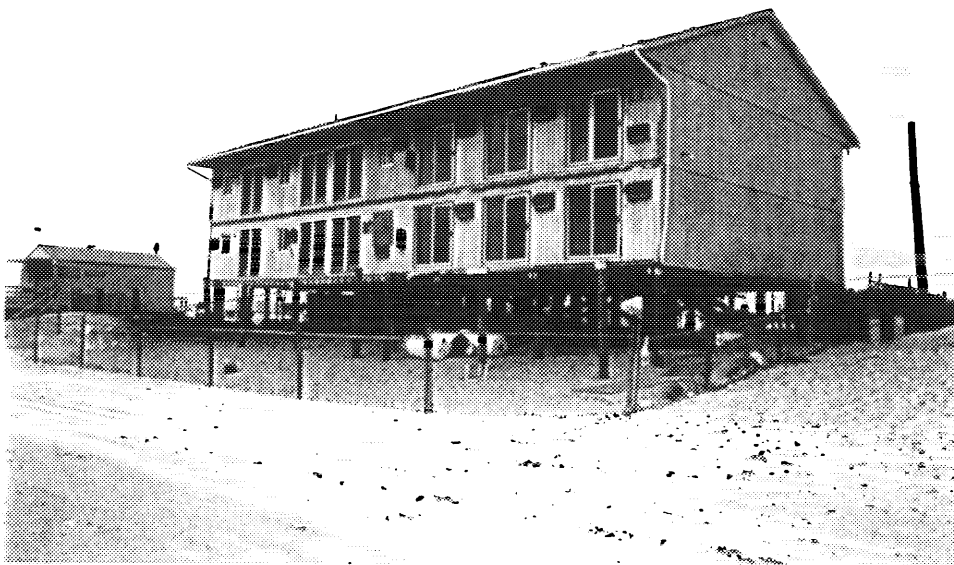
MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND



US Army Corps
of Engineers
New England Division



Misquamicut Beach - Commercial structures on eroded beach

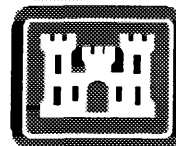


Misquamicut Beach - Shorefront structure damaged by storms

SHORE PROTECTION & FLOOD DAMAGE REDUCTION

PHOTOGRAPHS

MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND



**US Army Corps
of Engineers**

New England Division

PLATE 3



Low - lying residential area at Kimball and Franklin Avenues



West end of Atlantic Avenue near Little Maschaug Pond

SHORE PROTECTION & FLOOD DAMAGE REDUCTION

PHOTOGRAPHS

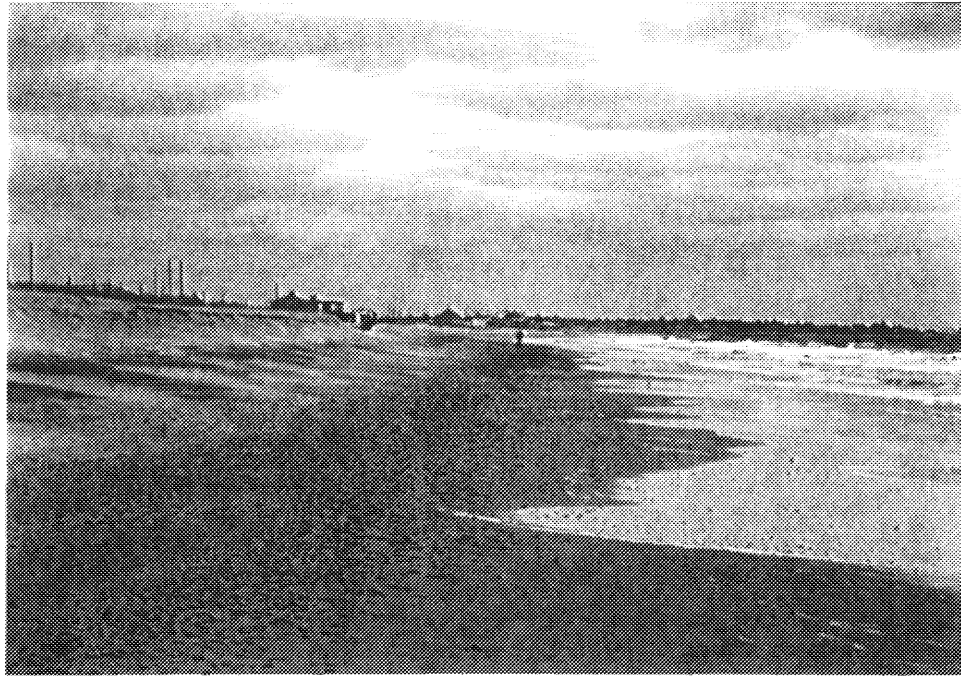
MISQUAMICUT BEACH , WESTERLY , RHODE ISLAND



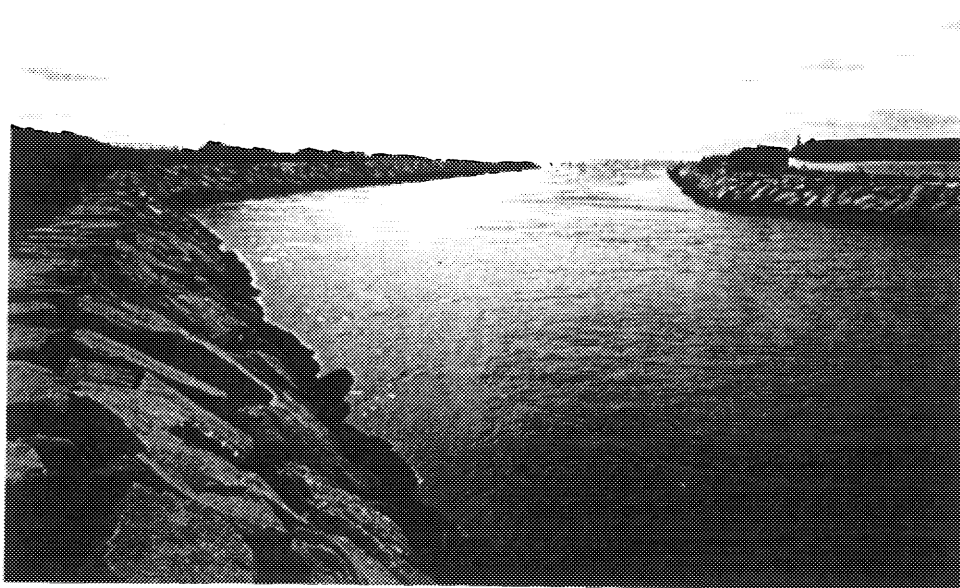
**US Army Corps
of Engineers**

New England Division

PLATE 4



Looking east at Misquamicut State Beach

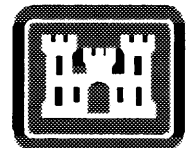


Weekapaug Breachway

SHORE PROTECTION & FLOOD DAMAGE REDUCTION

PHOTOGRAPHS

MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND



**US Army Corps
of Engineers**
New England Division

PLATE 5

A second meeting was held on April 14, 1993, with representatives of the Rhode Island Congressional delegation along with state and local officials.

An environmental coordination meeting was held at Misquamicut Beach itself on September 1, 1993. Among those who attended were representatives of the Rhode Island Coastal Resources Management Council (CRMC), the Rhode Island Department of Environmental Management (DEM), the Rhode Island Office of Systems Planning, the Rhode Island Salt Pond Watchers, the Sounds Conservancy and the Town of Westerly. As a follow-up to that meeting, CRMC sponsored a discussion of the Misquamicut area's environmental setting on September 24, 1993, with several members of the University of Rhode Island's departments of ocean engineering and geology present. Members of CRMC, DEM, and NED met again at Misquamicut Beach on September 29, 1993.

NED personnel met with the Westerly Town Council on September 20, 1993 to discuss study schedules and Federal study cost-sharing requirements.

PRIOR STUDIES AND REPORTS

A comprehensive plan to restore and protect Misquamicut Beach was developed by NED as an Interim Hurricane Survey of Westerly, Rhode Island, transmitted by the Secretary of the Army to Congress in July 1964. The project was subsequently authorized by Congress in December 1965. However, due to a lack of local interest, the project was never constructed and was subsequently de-authorized in January 1986.

A Bulletin published by the Corps' Coastal Engineering Research Center (CERC) in 1966 (Volume II, 1965-66) contained an article titled "Study Of Pilot Beaches In New England For The Improvement Of Coastal Storm Warning" dealing primarily with Misquamicut Beach. Another CERC report, "Beach Changes At Misquamicut Beach Rhode Island, 1962-1973", was published in November 1984.

In addition to these Corps reports, ICF Incorporated, a consultant to the New England / New York Coastal Zone Task Force, produced a report titled "Developing Policies To Improve The Effectiveness Of Coastal Flood Plain Management" dated July 1989. Misquamicut Beach was one of six sites studied for that report, which employed a mathematical model to predict future damages and shoreline changes due to various sea level rise scenarios and a 100 year storm surge. One of the report's conclusions was that, from a government perspective, beach nourishment may be the optimal policy for Misquamicut.

EXISTING PROJECT

In 1959, with both Federal and state participation, an area of beach 3250 feet long, at the present Misquamicut State Beach Reservation, was widened to 150 feet by direct placement of sand. In addition, 4075 feet of sand fencing was installed. The project was completed in May of 1960 at a cost of \$44,000. The State of Rhode Island was eligible for Federal assistance for 70 percent of the costs of nourishment over a ten year period from the initial nourishment.

PHYSICAL SETTING

Misquamicut Beach is located in the town of Westerly, Rhode Island about 4 miles south of Westerly's central business district. Misquamicut Beach is part of a narrow, sandy barrier beach that extends from headlands at Watch Hill Point to Weekapaug Point along Rhode Island's south shore that faces Block Island Sound. The study area consists of approximately 16,500 feet of shorefront and adjacent backshore areas between Little Maschaug Pond on the west and Weekapaug Breachway on the east. Much of the backshore area is occupied by Winnapaug Pond, a tidewater pond linked to the ocean by the Weekapaug Breachway.

Misquamicut Beach is at the western end of a narrow watershed extending from Watch Hill Point to Point Judith. The areal extent of this watershed is approximately 65 square miles. Geologically, the area consists of an outwash plain that formed ahead of a glacial terminal moraine. Shallow lagoons or embayments formed at the edge of the outwash plain. The actions of littoral currents resulted in the closing off of these embayments to form narrow beaches such as the one at Misquamicut. On-shore winds gave rise to dune formation.

Beach profiles reveal slopes that vary from 1 vertical to 5 horizontal at the duneline to flat slopes of 1:17 below the mean high water in the study area. The beach is composed of light brown fine and medium sand. The median grain size is about 0.3 mm at the mid-tide level and 0.8 mm at the high tide level. The mean tidal range is 2.6 feet.

ENVIRONMENTAL SETTING AND RESOURCES

The waters of Block Island Sound off the shores of Misquamicut Beach are considered to have very high aesthetic, wildlife habitat and recreational values.

Misquamicut Beach is a barrier beach exhibiting seasonal changes in the rates of sediment erosion and accretion. Sediment deposition in the study area is influenced by the Weekapaug Breachway, a man-made inlet at the east end of the beach.

The breachway leads into Winnapaug Pond and causes the level of the pond to be tidally influenced. Among the aquatic resources present in Winnapaug Pond are eelgrass, a variety of finfish and several commercial shellfish, notably quahogs, softshell clams, oysters and bay scallops. These shellfish are not particularly productive in Winnapaug Pond, however. Winnapaug Pond and Little Maschaug Pond, which is located at the west end of the study area, are both fringed with typical saltmarsh and wetland vegetation. Unlike Winnapaug Pond, Little Maschaug Pond contains mostly fresh water.

The Federally listed threatened Atlantic coast piping plover is known to nest on the outer beach of Maschaug and Little Maschaug ponds. Except for the occasional transient endangered bald eagles or peregrine falcons, no other Federally listed or proposed threatened or endangered species under the jurisdiction of the U.S. Fish and Wildlife Service occurs in the project area. Federally listed species that may occur in the project area during the summer include the leatherback, Kemp's ridley, green sea turtles (all endangered), and threatened loggerhead sea turtles.

PROBLEM DEFINITION

With the continuing seasonal loss of sand from the beach, along with a reduction in breadth and elevation of the existing dunes by erosive forces, many structures at Misquamicut Beach are now susceptible to damages from wave and tidal action associated with storms having as little as a five year recurrence interval. If no alternative solutions are found to protect the shorefront structures and reduce potential for overtopping and backshore flooding, the possibility exists that a very large storm could undermine and destroy shorefront structures and a significant portion of the homes located in the backshore area would be subjected to catastrophic flooding.

PLANNING GUIDANCE

Water resources planning undertaken by Federal agencies is directed by the Water Resources Council's Economic and Environmental Principles and Guidelines

for Water and Related Land Resources Implementation Studies. The economic and environmental principles contained in these guidelines relative to plan formulation were followed in this report so as to adhere to the Federal objective of contributing to the National Economic Development consistent with protecting the National environment. Various alternative plans were formulated in response to the erosion and flooding problems with a view toward enhancing national economic development and protecting environmental quality. Each of the several plans formulated was evaluated taking into consideration the completeness, effectiveness, efficiency, and acceptability of each plan.

WITHOUT PROJECT CONDITION

There has been a long-standing recognition of the erosion problem at Misquamicut Beach. A 1958 letter from the Secretary of the Army to Congress states that "insufficient material enters the area to replace losses". Over the years, accretion of sand has not matched the significant erosion caused by wind, tides and storms.

As a result, the shorefront area was very vulnerable at the time the two significant winter storms of 1992-93 occurred. The storms caused combined damages in excess of \$550,000. Representatives of the Coastal Engineering Research Center in Vicksburg, Mississippi, who toured Misquamicut Beach after the two storms, made an assessment that some of the structures located on the beachfront were susceptible to damages from as little as a five year storm event.

Due to the extent of damage that occurred in the winter of 1992-93 to dunes and revetments both fronting and adjacent to shorefront structures, the Coastal Resources Management Council of Rhode Island allowed exceptions to their policy governing movement of sand on the beach. Heavy equipment was used to reestablish sand berms in front of many homes and businesses. Most of the sand replaced came from deposits created by storm-wash behind the dune line. This activity will not, however, provide protection from storms larger than a five year event.

Hydrologic and hydraulic analysis for the study area presents several important conclusions. In addition to the need for shorefront protection, the Misquamicut area is vulnerable to flooding from Little Maschaug Pond, which is quickly filled by storm waves that overtop the low dunes on its south side. Winnapaug Pond can also be a source of flooding to backshore areas.

While there may be significant overtopping of the dunes at or near the Misquamicut Beach Reservation resulting in an increase to the level of the pond, large amounts of water can flow into the pond through the Weekapaug Breachway, particularly during storm events of longer duration.

The neighborhood at Misquamicut is, therefore, vulnerable to flooding from both its flanks, as well as from water present from waves locally overtopping the duneline in the area and normal patterns of runoff. A comprehensive solution to the problems at Misquamicut Beach must address both the shorefront and backshore vulnerabilities to storm damage and flooding.

The FEMA maps for Westerly show the extent of flooding that can occur for a 100 year event at Misquamicut. For the hydrologic analysis, the project area has been broken down into three flood zones. The first includes the beach area extending from the breachway about three miles west to the western edge of the village at Misquamicut. The second is the interior area consisting of the village at Misquamicut and the peripheral areas of Winnapaug Pond. The third zone is generally along the top of the dunes behind the first zone, to include those areas that are affected by wave overtopping waters that flow into the second zone. See Appendix A, Plate 1.

Using data from the hydrologic and hydraulic analysis, information was developed relative to the amount of past damages that have occurred and an estimate of future damages that may occur if no permanent protection measures are implemented. This information was used to estimate the annual damages that would be prevented in the study area with a protection project in place. Details for the project alternatives that were developed are shown in the Economic Analysis Section of this report. The complete hydrologic and hydraulic analysis is attached to this report as Appendix A.

In the absence of a project to reduce storm damages and flooding, the potential for shorefront and flood damages at Misquamicut Beach will remain as is. If there is no further development in the study area, recurring losses are expected to continue at the level established in this report.

It is possible to design a protection project that will substantially reduce backshore flooding for storms up to a 100 year event. This determination is based on comparing the wave runup and overtopping that is occurring along the existing beach with that which would be experienced with a protection project in place. Stage frequency curves developed for interior flooding are contained in Appendix A.

In order to determine the top of runup and volume of overtopping that is currently occurring along Misquamicut Beach, it was necessary to establish design parameters needed to compute wave heights and periods for various storm events. Data for the existing condition could then be compared to that calculated for a shore protection project in place.

Wind data was examined for the study area. Cases were considered for winds having return periods of 2, 5, 10, 25, 50 and 100 years blowing over a fetch length of 200 miles during periods of fully developed seas. The design wave heights and periods that were calculated using these parameters are shown in Table 1.

TABLE 1
WIND GENERATED WAVES
MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND

Return Period (Yrs)	Duration (Hrs)	Wind Speed (MPH)	Fetch (MI)	Wave Height (FT)	Wave Period (sec)
100	24	34	200	19.1	12.7
100	1	61	200	6.6	5.0
50	24	32	200	16.9	12.0
50	1	55	200	5.5	4.6
25	24	30	200	14.9	11.2
25	1	49	200	4.5	4.2
10	24	27	200	12.0	10.1
10	1	42	200	3.5	3.7
5	24	24	200	9.5	9.0
5	1	37	200	2.8	3.3
2	24	20	200	6.6	7.5
2	1	31	200	2.1	2.9

In August 1993, beach profiles were surveyed along 6,500 feet of Misquamicut Beach and nine reaches were established for use in calculating wave runup for existing conditions. A nearshore slope of 1 vertical to 100 horizontal was assumed, and wave heights for the various return periods noted above were adjusted for the wave to break at the toe of the structure.

The results indicated that no major overtopping would be experienced for a 5 year (20 percent chance) storm event at the lower, west end of the beach. The top of runup calculated for this event is elevation 9.3 feet NGVD. The top of runup calculated for a 10 year event is elevation 11.6 feet NGVD. Top elevations along the dune line for the west end of the beach fall between elevations 10 and 12 feet NGVD.

This indicates that overtopping for that portion of the beach begins at about the 10 year event. The volume of overtopping will increase as the frequency of the return periods considered decreases. Major overtopping will occur during the 100 year event as the top of runup was calculated to be over 17 feet NGVD. The following Table 2 shows this information in tabular form.

TABLE 2
EXISTING RUNUP AND OVERTOPPING CONDITIONS FOR A 12,000 FOOT REACH
AT THE WEST END OF MISQUAMICUT BEACH

<u>Return Period</u> <u>(Years)</u>	<u>Top of Average</u> <u>Wave Runup</u> <u>(feet. NGVD)</u>	<u>Average Height of</u> <u>Existing Berm</u> <u>(feet. NGVD)</u>	<u>Rate of</u> <u>Overtopping</u> <u>(CFS)</u>
100	17.2	11.0	27,400
50	16.3	11.0	N/A
25	14.3	11.0	N/A
10	11.6	11.0	10,800
5	9.0	11.0	no overtopping
2	7.2	11.0	no overtopping

A similar table was prepared to show calculated runup values with a protection project in place. The results are shown in Table 4 in the Economic Justification Section of this report, along with a summary of the effectiveness of a protection project in reducing overtopping and backshore flooding as defined by the stage frequency curves shown in Appendix A.

SCREENING OF ALTERNATIVES

Measures addressing coastal shore/flood damage reduction fall into two categories. Some modify the extent of shore damage/flooding by altering the natural environment; such as breakwaters, seawalls, revetments, dikes, etc. Others address shore/flood damage vulnerability through flood plain regulations, flood insurance, and flood proofing. The following is a list of measures that were considered either singly or in combination.

ALTERNATIVE SHORE/FLOOD DAMAGE PREVENTION MEASURES

MODIFYING SHORE / FLOOD DAMAGES

Breakwaters
Revetments
Beach Restoration
Groins
Walls or Dikes
Inlet Control Structure

REDUCE VULNERABILITY

Flood proofing
Relocation
Flood Warning and Evacuation
Flood Insurance

An effective solution to the problems at Misquamicut beach must address both shoreline protection and flood damage reduction. Below is a brief description and a summary of the study's findings for each type of measures investigated for Misquamicut Beach.

BREAKWATERS

A breakwater is a structure that can serve to protect a shore area, harbor, anchorage or basin from wave attack. Beaches and flood prone areas along the coast can be protected by a structure that reduces the wave energy reaching the shore. Breakwaters are generally some variation of an offshore rubble stone mound structure, adaptable to almost any depth and can be exposed to severe waves. The presence of an offshore breakwater would restrict some recreational activities like surfing.

Breakwaters can have both beneficial and detrimental effects on the shore. Offshore breakwaters are usually more costly than onshore structures, such as seawalls or revetments. The elimination of wave action not only provides protection but also reduces the movement of sand along the shore and can reduce the nourishment of the downdrift beaches.

At Misquamicut Beach, a breakwater would represent only the shore protection component of a proposed project that would also need to address flood control. Hence, a breakwater is not an effective stand alone measure. The cost of a rubble stone mound breakwater located offshore was found to be prohibitive, with an estimated cost far in excess of benefits to be derived.

A number of alternative breakwater designs have been developed using materials other than stone. Almost any breakwater design will promote accretion of sand behind it; however, the dimensions of the new beach would be uncertain, and utilization of a breakwater would likely require supplemental sand fill on the beach to achieve a berm height required for meaningful protection at Misquamicut. The costs associated with such plans would need to be carefully evaluated on a case by case basis, along with their overall effectiveness and environmental acceptability.

Due to these issues regarding both the cost and the effectiveness of a breakwater, and the necessity of relying on other measures to achieve flood protection, it was therefore dropped from further consideration in this study.

REVETMENTS

Sloping revetments armor the seaward face of a shoreline with one or more layers, generally of stone or concrete. This sloping protection dissipates wave energy, with a less damaging effect on the shore. Two types of structural revetments are commonly used for coastal protection: the rigid, cast-in-place concrete type and the stone armor unit type.

On the negative side, revetments will displace beach area which is contrary to the objective of protecting the area's recreational and aesthetic values.

Like the breakwater, the cost of revetment was found to be prohibitive, with estimated costs far in excess of benefits to be derived. Accordingly, it too was dropped from further consideration in the reconnaissance study.

BEACH RESTORATION AND NOURISHMENT

Beaches are very effective in dissipating wave energy. When maintained to adequate design dimensions, they can afford protection for the adjoining backshore. When conditions are suitable, long reaches of shore may be protected by artificial nourishment. The resultant widened beach also has added value as a recreational feature. A profile of a typical beachfill design is shown in Figure 6.

This shore protection measure will be evaluated in more detail in subsequent pages of this report.

GROINS

Groin structures are shore protection structures usually built perpendicular to the shoreline to trap longshore littoral drift or retard erosion of the shore. They can also be used in conjunction with sand fill to compartmentalize the sand and keep it in place. The Rhode Island Coastal Resources Management Council suggested that groins at Misquamicut Beach could cause damage due to sand starvation at other beaches in the Block Island Sound coastal system. Groins may also decrease recreational opportunities at the beach. The proposal to use groin structures is therefore removed from further consideration in this study.

WALLS AND DIKES

Floodwalls and dikes may be constructed to protect properties that would otherwise suffer first floor inundation from high water during large storms. They may be laid out to surround or isolate the area to be protected by tying in to high ground. Flood walls are usually constructed of reinforced concrete and steel sheet pile, while dikes are built of earth and stone. The width of a typical wall is around two feet, while the footprint of a typical dike is many times wider. Pump stations may be required to remove local drainage that may accumulate behind a floodwall or dike structure. Both floodwalls and dikes are very effective measures that were selected for further study. Typical sections for a wall and a dike are presented in Figures 2 and 3.

INLET CONTROL STRUCTURE

An inlet control structure to be located at the Weekapaug Breachway was an element of the proposed Corps project of the 1960's. In conjunction with a beach berm of sufficient height, the inlet control structure could control the level of Winnapaug Pond and prevent flooding of the backshore areas adjacent to the pond. The design, which was updated from the former proposal, would provide a fifty foot, gated opening for navigation and several smaller flushing gates that would maintain tidal flow in and out of the pond. Tie-in dikes for the inlet control structure would be located on either side of the breachway. The gated inlet control structure as a means of flood control would influence a particularly large backshore area, so it was chosen for further evaluation. Conceptual details of an inlet control structure and its tie-in dike are presented in Figures 4 and 5.

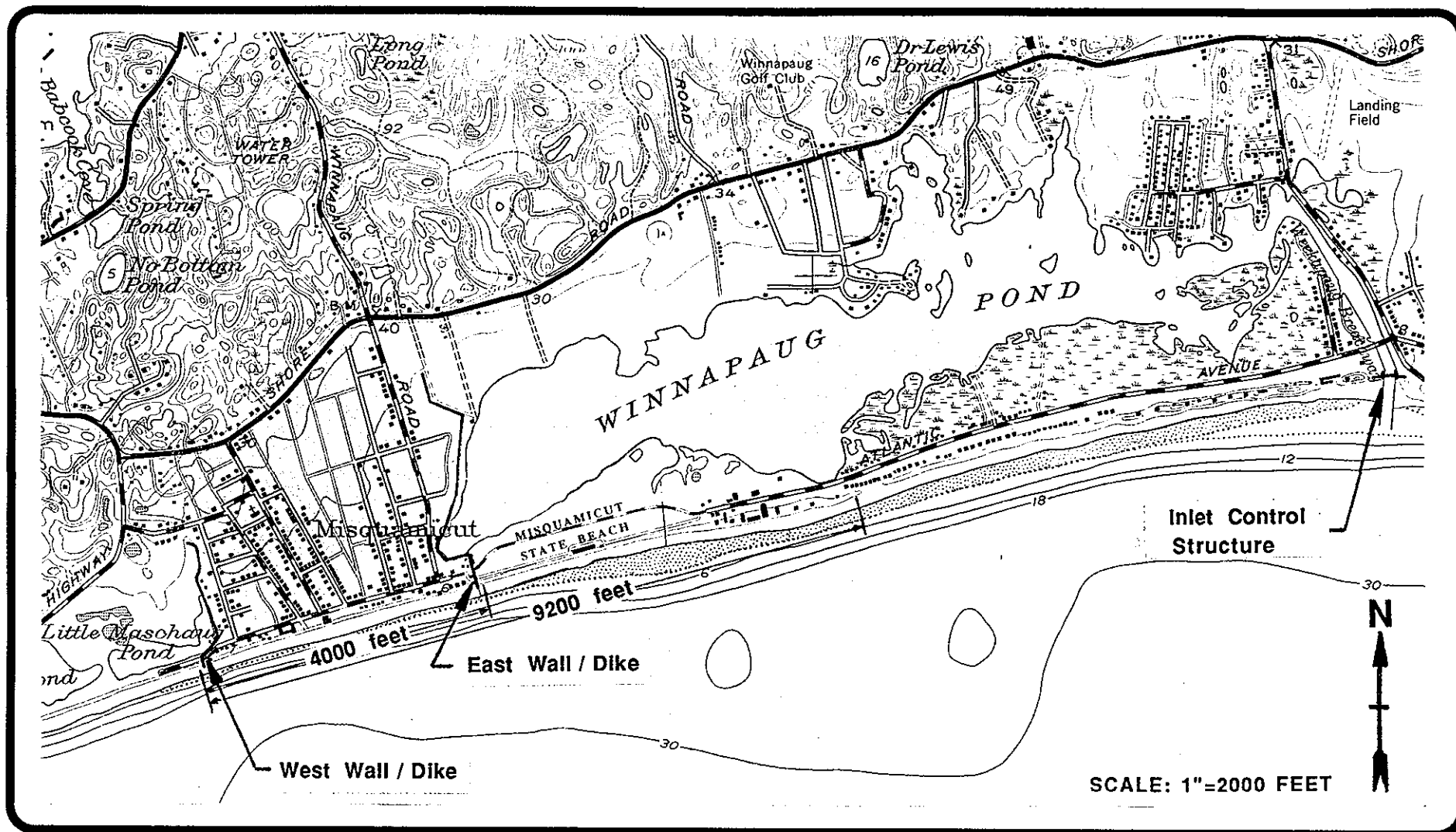


FIGURE 1

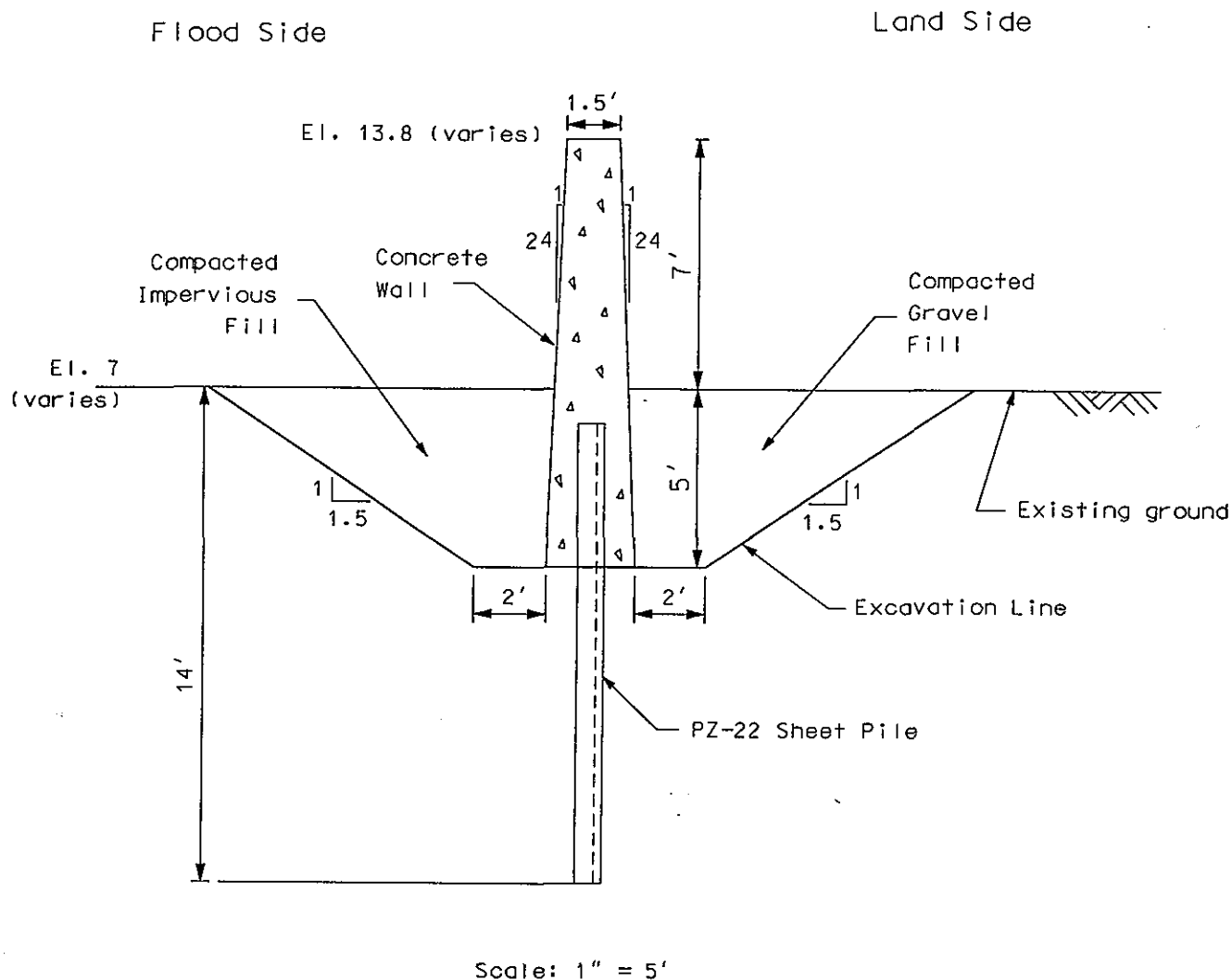
SHORE PROTECTION & FLOOD DAMAGE REDUCTION

LOCATION OF THE ELEMENTS OF VARIOUS ALTERNATIVE PLANS

MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND



US Army Corps
of Engineers
New England Division



NOTE:
All elevations are ft-NGVD

SHORE PROTECTION & FLOOD DAMAGE REDUCTION

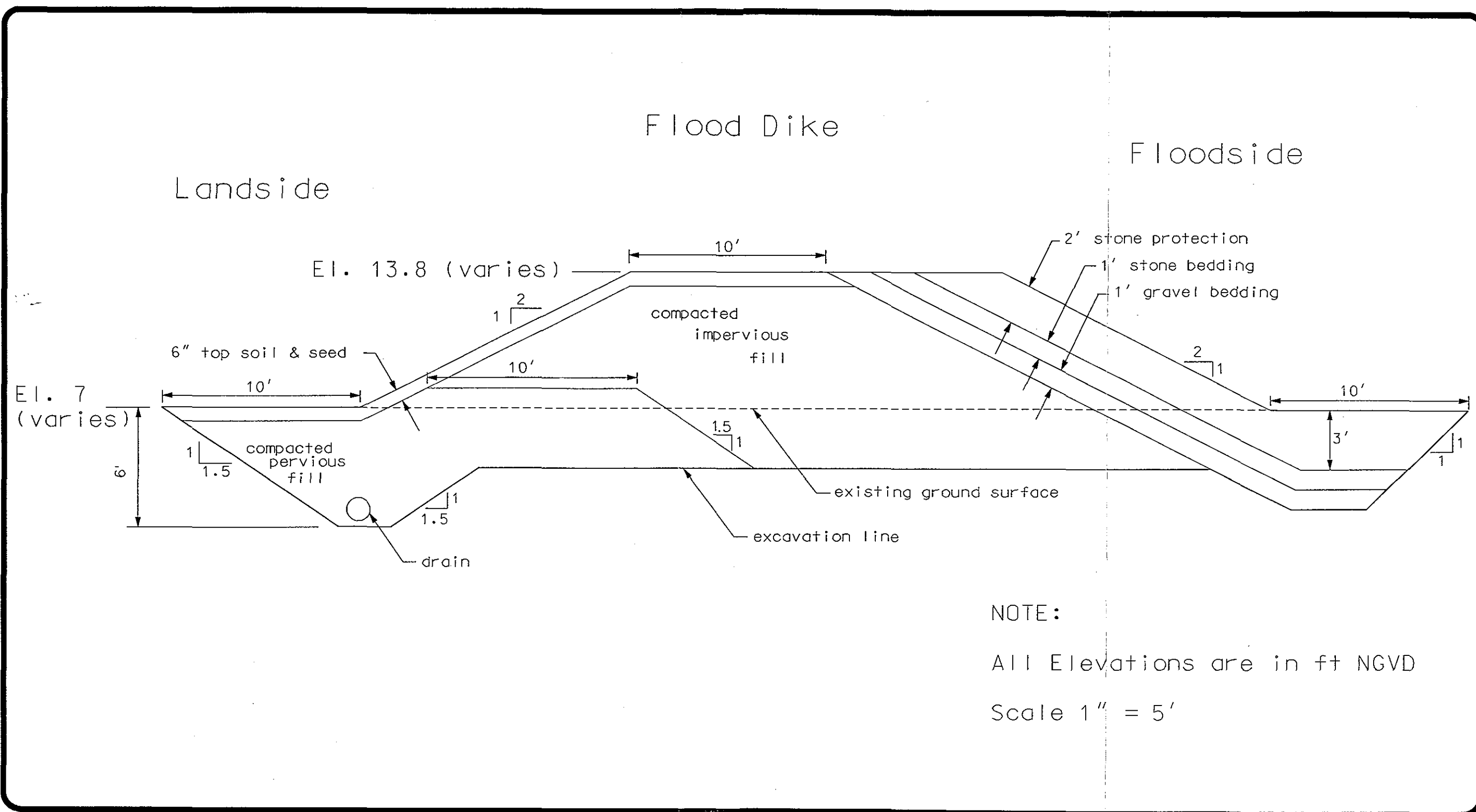
TYPICAL WALL SECTION

MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND



US Army Corps
of Engineers
New England Division

FIGURE 2



SHORE PROTECTION & FLOOD DAMAGE REDUCTION

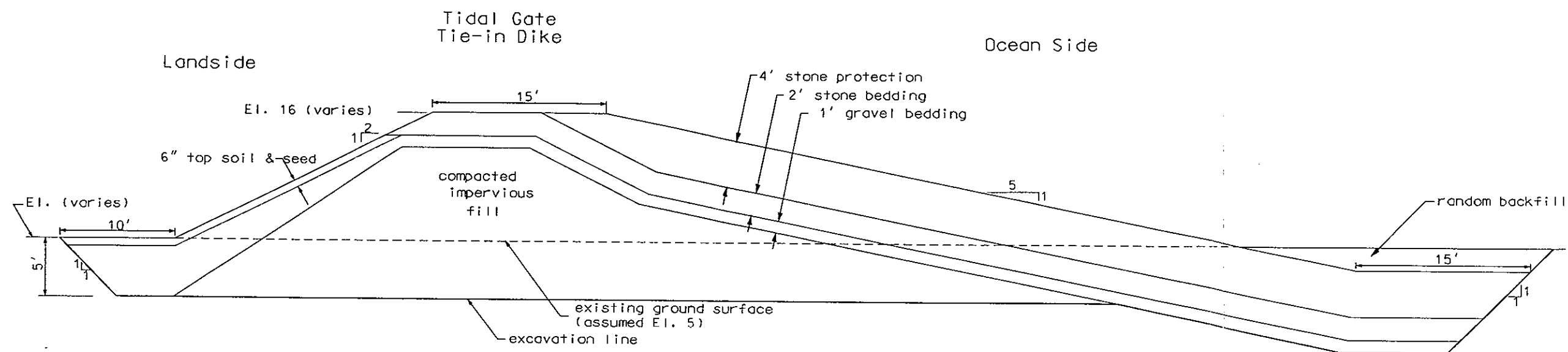
TYPICAL DIKE SECTION

MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND



US Army Corps
of Engineers
New England Division

FIGURE 3



NOTE:

All Elevations are in ft NGVD

Scale 1" = 10'

SHORE PROTECTION & FLOOD DAMAGE REDUCTION

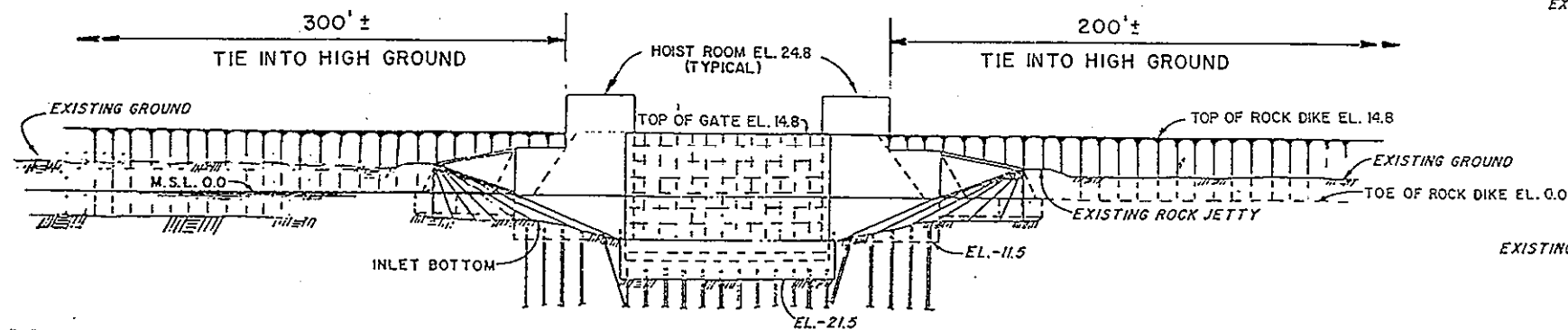
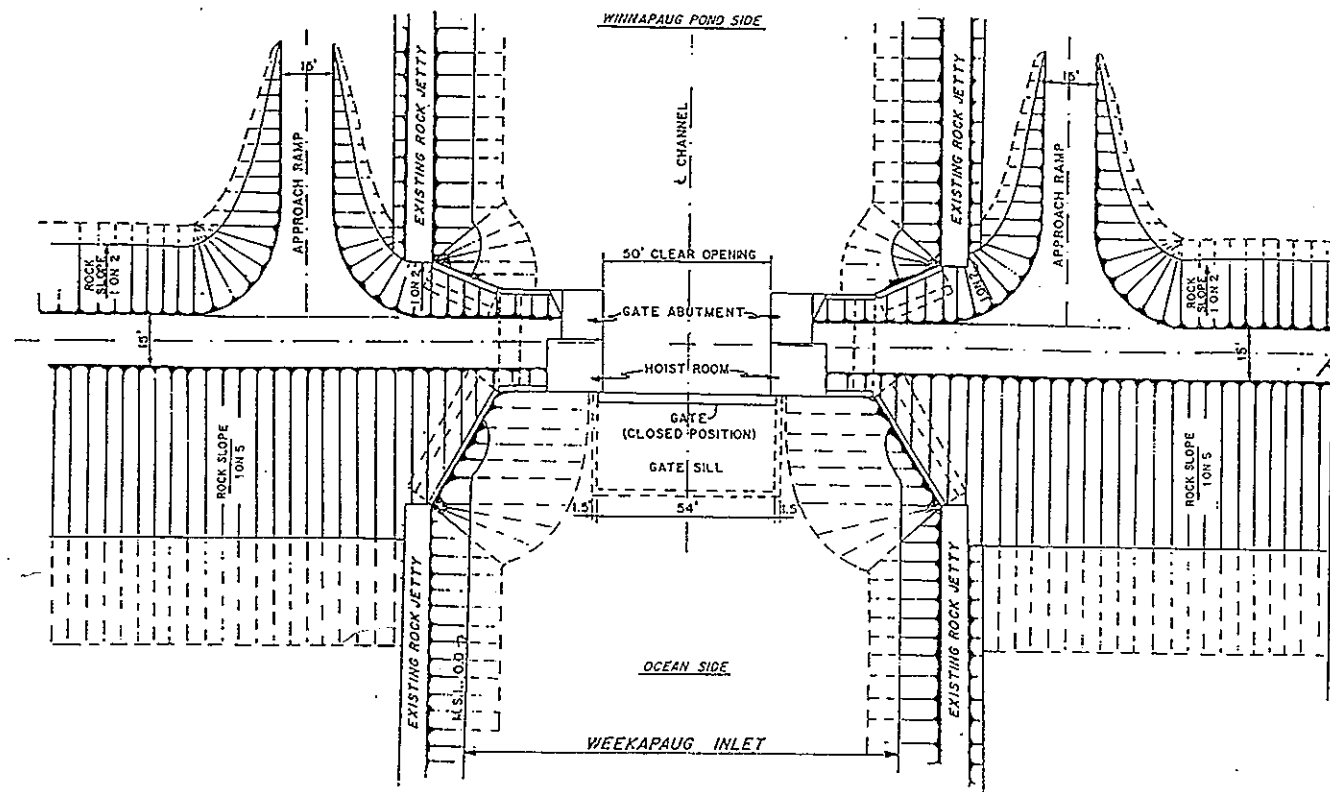
TIE - IN DIKE SECTION AT INLET CONTROL STRUCTURE

MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND



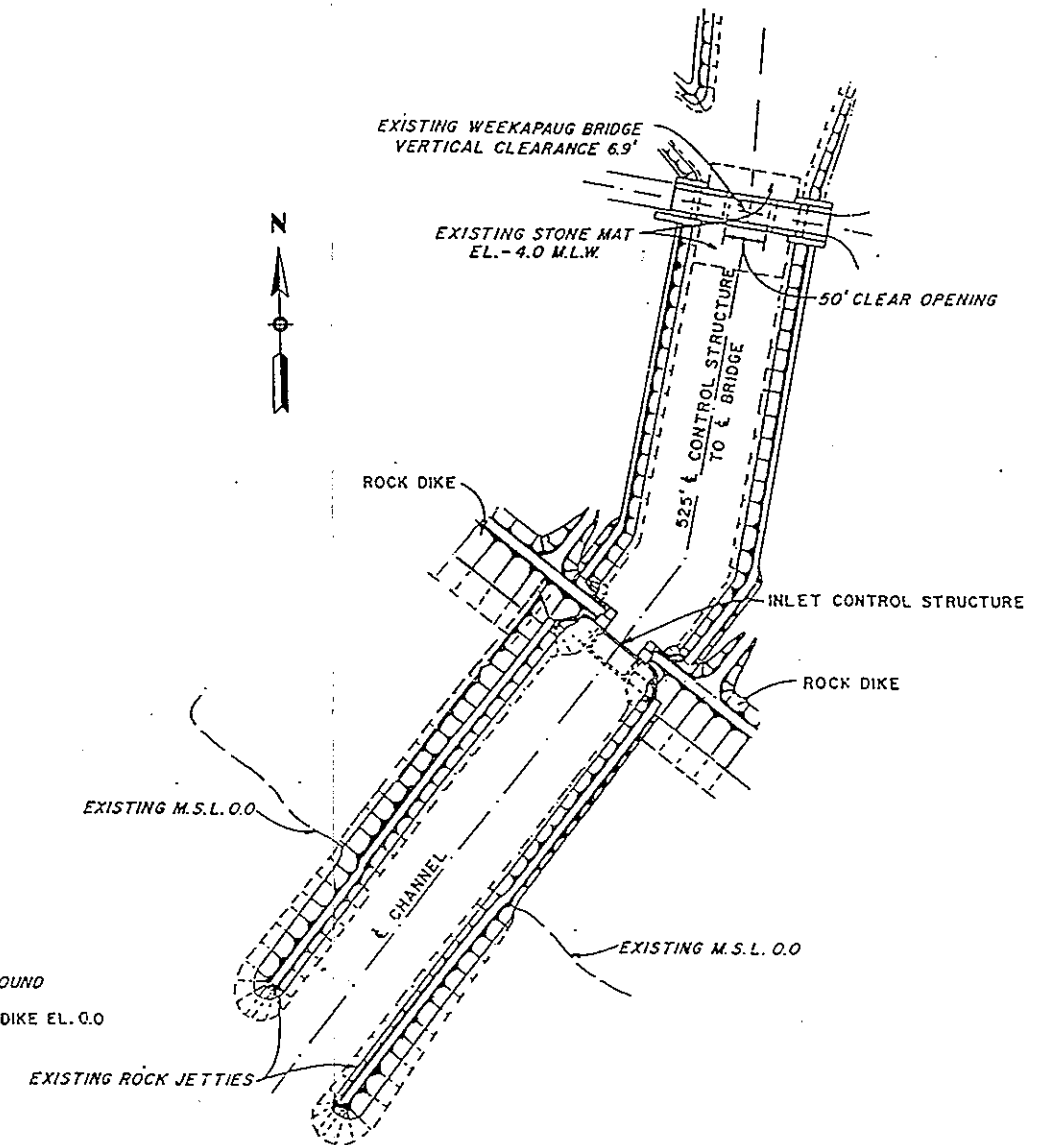
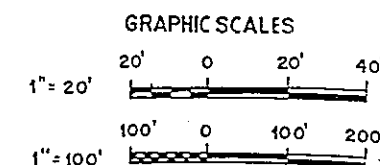
US Army Corps
of Engineers
New England Division

FIGURE 4



NOTES:

1. STEEL "H" PILES DRIVEN TO REFUSAL.
2. ABUTMENT PILES AT 5.0' O.C. EACH WAY.
3. STILL PILES AT 5.0' O.C. EACH WAY.
4. GATE ALSO PROVIDED WITH REMOTE CONTROL FOR EMERGENCY OPERATION.
5. ELEVATION OF TOP OF DIKE AND TOP OF GATE VARIES WITH LEVEL OF PROTECTION. ELEVATIONS SHOWN REFLECT PROTECTION FOR A 25 YEAR EVENT.
6. FLUSHING GATES NOT SHOWN.



SHORE PROTECTION & FLOOD DAMAGE REDUCTION

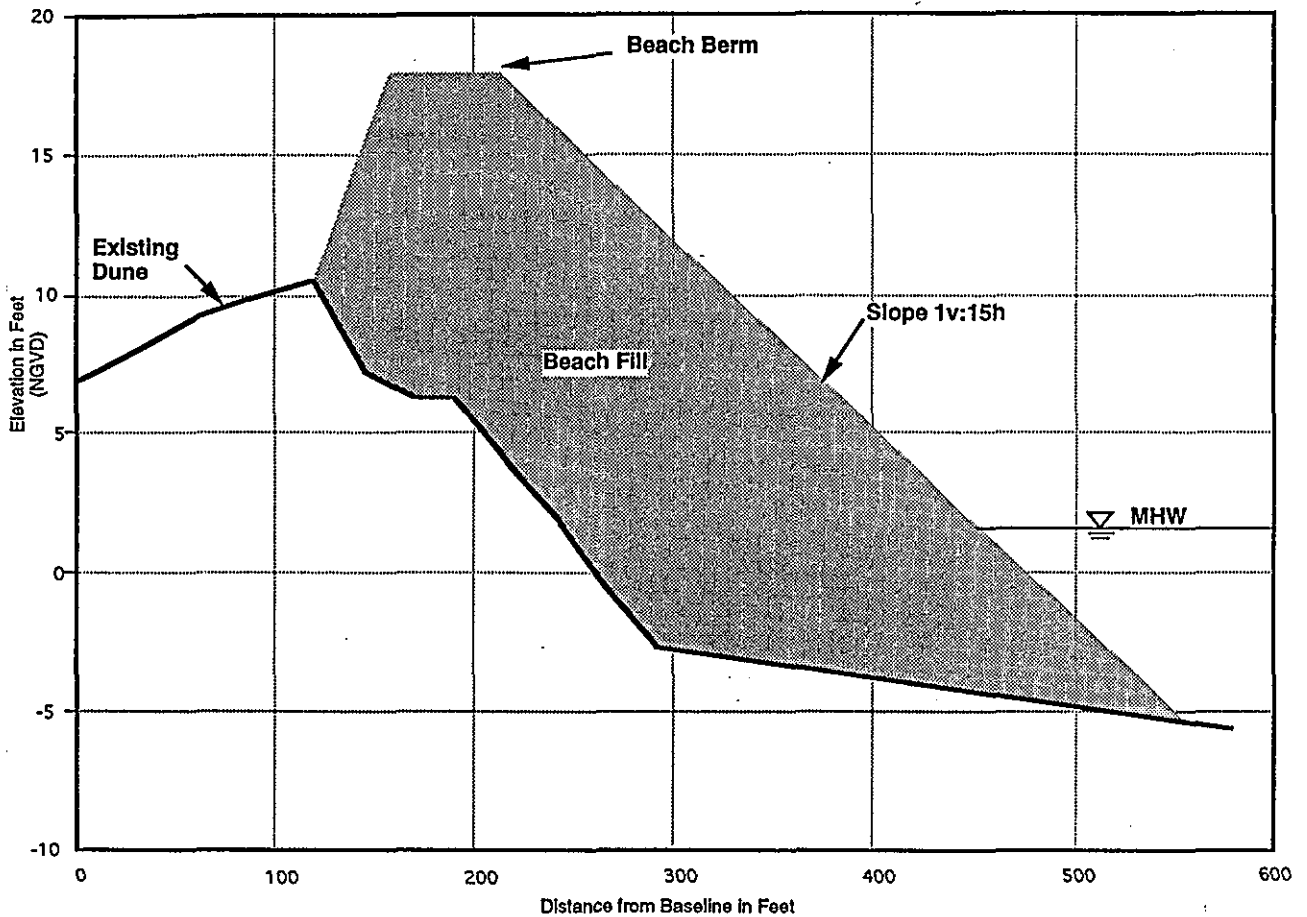
INLET CONTROL STRUCTURE

MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND



US Army Corps
of Engineers
New England Division

FIGURE 5



SHORE PROTECTION & FLOOD DAMAGE REDUCTION

PROFILE OF TYPICAL BEACHFILL DESIGN

MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND



US Army Corps
of Engineers
New England Division

FIGURE 6

FLOOD PROOFING

Flood proofing encompasses several techniques for preventing damages due to floods, requiring action both to structures and to building contents. It involves keeping water out, as well as reducing the effects of its entry. Such adjustments can be applied by the individual, or as part of a collective action, either when buildings are under construction or during remodeling.

Flood proofing measures can be classified into three broad categories. First are permanent measures which become an integral part of the structure or land surrounding it. Second are temporary or standby measures which are used only during floods, which are constructed and made ready prior to any flood threat. Third are emergency measures which are carried out during flood situations in accordance with a predetermined plan. Flood proofing is considered to be a "nonstructural" measure.

Typical nonstructural measures include closure for openings (doors, windows, etc.), waterproof sealants for walls and floors, utility valves to prevent backflow of sewer and plumbing facilities, and sump pumps. Another technique is raising existing structures above design flood levels.

Within an existing group of structures, damageable property can often be placed in a less vulnerable location or protected in-place. Heating plants and appliances can be protected by raising them off the floor. Damageable property can be moved from lower to higher floors, or other less floodprone sites. Important mechanical and/or electrical equipment can be flood proofed by enclosing it in a watertight utility cell or room.

An important caveat is that some residual damage to both the structure and contents will remain even when the most vulnerable property is rearranged or protected. Flood proofing measures are usually considered when the depth of flood is relatively shallow.

Elimination of flood damages can also be accomplished by relocation of existing floodprone structures and/or contents. There are basically two options for removing property to a location outside the flood hazard area. One is to remove both structures and contents to a flood-free site; the second is to remove only the contents to a structure located outside the flood hazard area, and demolish or reuse the structure at the existing site.

Much of the losses that have been recently experienced in the study area have been as a result of storm damage to shorefront areas. These properties are located south of Atlantic Avenue at or near the crest of the dune line, and structures there are among the highest in the study area. The backshore, particularly the Misquamicut neighborhood, features generally lower ground elevations. Many of the structures located north of Atlantic Avenue were either built or have been raised such that the first floor elevations are above the 100 year flood level. However, the potential for significant damages to the remaining low-lying structures was identified in an inventory of study area properties. Accordingly, flood proofing has been selected for further evaluation.

RELOCATION

Relocation of structures to new locations outside of the 100 year floodplain is an effective means to curtail the flood damages. The benefits of such a plan would have to be sufficient to support the acquisition of these properties, and would be contingent upon the availability of accommodations for the displaced families. The cost of such a plan, assuming that suitable tracts were available for relocation, was judged to be prohibitive when compared with estimates of annual flood damages.

FLOOD WARNING AND EVACUATION

Flood forecasts, warning and evacuation is a strategy to reduce flood losses by charting out a plan of action to respond to a flood threat. The strategy should include:

- A system for early recognition and evaluation of potential floods.
- Procedures for issuance and dissemination of a flood warning.
- Arrangements for temporary evacuation of people and property.
- Provisions for installation of temporary protective measures.
- A means to maintain vital services.
- A plan for post flood reoccupation and economic recovery of the area.

Flood warning is the critical link between forecast and response. An effective warning process will communicate the current and projected flood

threat, reach all persons affected, account for the activities of the community at the time of the threat (day, night, weekday, weekend) and motivate persons to action. The decision to warn must be made by responsible agencies and officials in a competent manner to maintain the credibility of future warnings.

An effective warning needs to be followed by an effective response. This means prompt and orderly evacuation and/or action. This includes:

- Establishment of rescue, medical and fire squads.
- Identification of rescue and emergency equipment.
- Identification of priorities for evacuation.
- Surveillance of evacuation to insure safety and protect property.

The town of Westerly has a flood warning and evacuation plan. When an approaching storm is less than 48 hours away, residents are alerted through the local cable television station and radio. Prior to landfall in the Misquamicut area, all roads and access to the area south of Shore Road (Route 1A) are closed, and residents are asked to evacuate. The Westerly High School is the primary designated emergency shelter, and has a capacity of approximately 500 persons.

However, warning and evacuation alone do not prevent widespread flooding and the physical damage it brings. Accordingly, flood warning and evacuation has not been selected for any further detailed evaluation in this report.

FLOOD INSURANCE

Flood Insurance is not really a flood damage reduction measure: rather it provides protection from financial loss suffered during a flood. The National Flood Insurance Program was created by Congress in an attempt to reduce, through more careful planning, annual flood losses and to make flood insurance protection available to property owners.

The program provides local officials with a usable tool in protection of their flood plains. A flood-prone community, once in the regular program, must enact flood plain zoning in accordance with minimum guidelines established by the Federal Emergency Management Agency (FEMA). Westerly is such a community and they have adopted appropriate flood plain zoning regulations.

Without implementation of measures for flood damage reduction, the financial losses associated with flooding will continually be a burden. Like other flood plain regulations, use of flood insurance is encouraged. However, it also does not reduce the physical damage and social disruption caused by a flood. Since the town of Westerly currently is a member of the National Flood Insurance Program, further study of the flood insurance option was not necessary.

PLAN FORMULATION

The need for effective flood damage reduction measures, as well as a means to limit the study area's susceptibility to storm damage, was established in the earlier discussion of the without-project condition. In an area as complex as Misquamicut, a solution involving a combination of measures was indicated. The following alternatives were evaluated as possible measures for shorefront protection and flood damage reduction at Misquamicut Beach:

- Alternative A
(As below, evaluated for 10, 25, 50 and 100 year levels of protection.)
A 4000 foot beach berm to run from the vicinity of Little Maschaug Pond to the west end of the Misquamicut State Beach, with a floodwall running north approximately 2100 linear feet from the berm past the east shore of Little Maschaug Pond to tie into high ground near the edge of the Misquamicut Club golf course, and a second floodwall running north approximately 3800 linear feet from the berm past the west shore of Winnapaug Pond to tie into high ground on farmland near Shore Road. A pump station of 55 CFS capacity would be provided for interior drainage.
- Alternative B
(As below, evaluated for 10, 25, 50 and 100 year levels of protection.)
A 9200 foot beach berm to run from the vicinity of Little Maschaug Pond to the east end of the Westerly Town Beach, with a floodwall running north approximately 2100 linear feet from the berm past the east shore of Little Maschaug Pond to tie into high ground near the edge of the Misquamicut Club golf course, and a second floodwall running north approximately 3800 linear feet from the berm past the west shore of Winnapaug Pond to tie into high ground on farmland near Shore Road. A pump station of 55 CFS capacity would be provided for interior drainage.

- Alternative C

(As below, evaluated for 10, 25, 50 and 100 year levels of protection.)
A 9200 foot beach berm to run from the vicinity of Little Maschaug Pond to the east end of the Westerly Town Beach, with a floodwall running north approximately 2100 linear feet from the berm past the east shore of Little Maschaug Pond to tie into high ground near the edge of the Misquamicut Club golf course, and an inlet control structure located at the Weekapaug Breachway.

- Alternative D

A 9200 foot beach berm designed for a 100 year level of protection to run from the vicinity of Little Maschaug Pond to the east end of the Westerly Town Beach, and a total of 186 homes in the Misquamicut village area whose first floor elevations are below that of the 100 year flood elevation (El. 12.0 feet NGVD) to be raised to that level.

A comparison of costs associated with these alternatives is presented in Table 3 on Page 18. The elements of the alternatives are itemized for each level of protection (L.O.P.), and the benefit to cost ratio of each plan is included.

Based on preliminary studies accomplished in the reconnaissance phase, only one of the alternatives was found to be marginal with economic justification just below unity. The project, described above as Alternative A.4, involves placement of sand fill along approximately 4,000 feet of beach from the western limit of study near Little Maschaug Pond to the western end of the Misquamicut State Beach Reservation along with a 2100 foot floodwall east of Little Maschaug Pond and a 3800 foot floodwall west of Winnapaug Pond. These elements would be designed to provide a 100 year level of protection for the affected shoreline and the area between the floodwalls. This shore and flood protection alternative would require more detailed evaluation to demonstrate economic feasibility before a definite project could be implemented. The total cost of a cost-shared feasibility study for development of that alternative is estimated to be \$540,000.

South of the existing dune line, the project would provide for a 50 foot wide level beach berm at elevation 17.9 feet NGVD. From here the beach face would then slope seaward with a slope of 1 vertical and 15 horizontal until it intersects the existing ground. This would then provide a protective beach averaging 280 feet in width behind the mean high water line. A typical beachfill project profile is shown in Figure 6.

With the beach fill in place, the waves will break farther offshore and run up the face of the beach. The new berm elevation of 17.9 feet NGVD will not be overtopped by storm waves having a 100 year return frequency or less. During more intense storms with return frequencies of greater than 100 years, if the beach is in place and at its full design dimensions, overtopping of the dunes will be substantially reduced. See Appendix A.

TABLE 3
COMPARISON OF ALTERNATIVE PLANS
(COSTS IN \$ 000 ' S)

ALT. NO.	L.O.P.	BEACH BERM	WEST WALL	EAST WALL	PUMP STA.	INLET CONT. STR.	REAL EST.	E & D, CONST. MGT.	TOTAL COST	I & A, O & M	BEACH RENOUR.	ANN. CHAR.	ANN. BEN.	BCR
A1	10 YR.	\$5291	\$452	\$1139	\$625	----	\$2600	\$1212	\$11320	\$1010	\$66	\$1076	\$417	0.4
2	25 YR.	\$7863	\$618	\$1291	\$625	----	\$2600	\$1560	\$14557	\$1295	\$66	\$1361	\$994	0.7
3	50 YR.	\$10083	\$770	\$1474	\$625	----	\$2600	\$1867	\$17418	\$1547	\$66	\$1613	\$1381	0.9
4	100 YR.	<u>\$11205</u>	<u>\$770</u>	<u>\$1474</u>	<u>\$625</u>	----	<u>\$2600</u>	<u>\$2001</u>	<u>\$18675</u>	<u>\$1658</u>	<u>\$66</u>	<u>\$1724</u>	<u>\$1580</u>	<u>0.92</u>
B1	10 YR.	\$8541	\$452	\$1139	\$625	----	\$2600	\$1603	\$14960	\$1332	\$162	\$1494	\$548	0.4
2	25 YR.	\$13570	\$618	\$1291	\$625	----	\$2600	\$2244	\$20948	\$1861	\$162	\$2023	\$1351	0.7
3	50 YR.	\$18088	\$770	\$1474	\$625	----	\$2600	\$2827	\$26384	\$2341	\$162	\$2502	\$1674	0.7
4	100 YR.	\$20388	\$770	\$1474	\$625	----	\$2600	\$3103	\$28960	\$2568	\$162	\$2731	\$1848	0.7
C1	10 YR.	\$8541	\$452	----	----	\$2610	\$1650	\$1591	\$14843	\$1291	\$162	\$1453	\$551	0.4
2	25 YR.	\$13570	\$618	----	----	\$2737	\$1650	\$2229	\$20804	\$1818	\$162	\$1979	\$1352	0.7
3	50 YR.	\$18088	\$770	----	----	\$2820	\$1650	\$2799	\$26127	\$2287	\$162	\$2450	\$1699	0.7
4	100 YR.	\$20388	\$770	----	----	\$2863	\$1650	\$3081	\$28752	\$2520	\$162	\$2682	\$1873	0.7
<div style="display: flex; justify-content: space-around; margin-top: 10px;"> <u>BEACH BERM</u> <u>RAISE HOMES</u> </div>														
D1	100 YR.	\$20388	-----		\$7663	-----		\$3367	\$31417	\$2744	\$162	\$2906	\$1792	0.6

NOTES: • ALTERNATIVE A INCLUDES 4000 FOOT BEACH BERM.
 • ALTERNATIVES B & C INCLUDE 9200 FOOT BEACH BERM.
 • E & D = ENGINEERING AND DESIGN, RATE = 7 % , CONSTRUCTION MANAGEMENT RATE = 5 %
 • I & A = INTEREST AND AMORTIZATION, RATE = 8.25 %
 • O & M = OPERATION AND MAINTENANCE, SAY 0.5 % OF BEACH COST PLUS 5 % OF PUMP STA. COST.

Surveys performed as part of the reconnaissance study yielded profiles that were used as the basis to estimate volumes of sandfill necessary to construct the beach to the proposed design dimensions noted above. Survey measurements show that 660,000 cubic yards of sand are necessary for the protective beach.

An issue of concern to the Town of Westerly from the beginning of the reconnaissance study process was the feasibility of dredging beachfill material from Winnapaug Pond. Seven borings were made and a lab analysis of the samples conducted. A majority of samples revealed an upper layer of material that is considered too fine for use as beachfill. Only one sample showed a suitable grain size at a depth of six to eight feet. Even if this layer were extensive enough to provide the enormous quantity of sand necessary to construct the project, the economy of extracting it from beneath the overlying six feet of fine sand and silt is questionable. A related issue would be a production rate that would be low, with perhaps only 100,000 cubic yards of material being available annually. Although there may be environmental benefits from dredging Winnapaug Pond, the idea does not appear to be feasible from an engineering standpoint, since suitable material in sufficient quantities cannot be guaranteed. More information on the geotechnical investigations is found in Appendix D.

A preliminary material source survey has shown that suitable beach fill can be obtained from several land-based borrow pits within a 30 mile radius of the beach. It is anticipated the material will have a median diameter of between 0.4 to 0.75 mm, ranging between the median grain sizes of native material samples taken at mid and high tide levels. This material will be more resistant to the erosive forces in the area and thus reduce annual losses that have been experienced in the past. The annual nourishment requirements are based on historic records with an adjustment for a more stable beach fill. At an estimated cost of \$17 per cubic yard, the first cost of the beach fill component of the project is estimated to be \$11,205,000. Offshore sand sources were investigated but were found to be more expensive. Removal of the bars located just offshore at Misquamicut would be unwise, as they already provide some protection to the shoreline area.

In order for Federal involvement to be possible for a project in this area, public access to the beach area would have to be negotiated with the property owners. The Coastal Resources Management Council of Rhode Island has stated that it will require similar public access provisions.

The floodwalls would be constructed of cast in place, reinforced concrete over driven steel sheet pile. A gate or stoplog closure would be required to span the opening in the wall built on the Winnapaug Pond side where it crosses Atlantic Avenue. Both walls must be aligned to avoid wetlands delineated by Rhode Island DEM and the Corps. The costs associated with both floodwalls, including real estate estimates is \$4,844,000. In the section of the report in which alternative measures were screened, dikes and floodwalls were mentioned as equally effective means for protecting properties from flooding. At Misquamicut, the impacts to properties, and hence the overall cost of each of the alternatives, were less for floodwalls than for dikes. Floodwalls were chosen in each case to minimize potential relocations and associated real estate costs.

The total first cost of the selected alternative is \$18,675,000. The annual project cost including interest and amortization of the first costs, costs for engineering, design and construction management, operation and maintenance and future nourishment, based on historic records, is estimated at \$1,724,000. The annual operation and maintenance cost, which is a non-Federal responsibility, is taken as 0.5 percent of the beach berm cost plus 5 percent of the first cost of the pump station. A more detailed financial analysis of the project cost is presented in Table 6.

ECONOMIC ANALYSIS

The reconnaissance level economic analysis compared damages that would occur to the shorefront and backshore structures with the cost of the shore protection and flood damage reduction alternatives put forth in this study. The damage figures are based on information obtained by New England Division on damages from several past storms and estimates of vulnerability to interior flood damages based on stage frequency curves shown in Appendix A.

During recent times, sand has been eroded from in front of the homes and businesses along Atlantic Avenue, particularly in the area west of Misquamicut State Beach. As a result, during the December 1992 coastal storm a number of shorefront structures sustained minor damages. Damages to commercial buildings and property in that area totaled \$202,000. Emergency repairs were made to the sand berms that fronted the development.

Flood damages to the backshore during the December, 1992 storm were not severe. There were no reports of backshore structures experiencing any first floor flooding.

Projected benefits result from the reduction in damages to the shorefront structures and the reduction in flooding damages to the backshore that could be attributed to the project. Damage reduction benefits are equal to the difference between damages with and without the project in place. In addition to these protection benefits, the project will also increase the amount of recreational beach area available for use by the general public during all stages of the tide.

For the identified alternative, the annual benefits for shorefront and backshore flood damage reduction are estimated to be \$1,580,000.

As was noted in the Without Project Condition Section of the report, runup calculations were prepared with the beach project in place for the various return periods and design wave heights shown in Table 1. The results are shown in Table 4.

TABLE 4
TOP OF AVERAGE WAVE
RUNUP ALONG THE PROPOSED PROTECTIVE BEACH
WITH A SLOPE OF IV : 15H

<u>Return Period (Years)</u>	<u>Top of Average Wave Runup (feet, NGVD)</u>	<u>Average Height of Top of Berm (feet, NGVD)</u>	<u>Volume of Overtopping (CFS)</u>
100	17.2	17.9	no overtopping
50	16.3	17.9	no overtopping
25	14.3	17.9	no overtopping
10	11.6	17.9	no overtopping
5	9.0	17.9	no overtopping
2	7.2	17.9	no overtopping

The annual storm damage reduction benefits to be attributed to the beach berm are \$207,400.

There are currently 318 homes, eight hotels, and several other commercial structures in the Misquamicut neighborhood that are located in the 100 year floodplain. Using the stage frequency curves in Appendix A, the expected annual flood damages to the backshore area for the existing conditions are \$730,300.

The benefits to the backshore area are derived from the protection against flooding that would be provided by the floodwalls constructed to protect the Misquamicut residential area. Those floodwalls, in combination with the 4000 foot beach berm, would prevent flooding in the Misquamicut residential area up to the 100 year flooding event. The annual flood damage reduction benefits in the Misquamicut area equal the value of the annual losses in the Misquamicut area at the 100 year event, which equal \$613,400.

Improvements to the beach will provide a greater area available for recreation, as well as a more aesthetically pleasing beach than that that is existing. Recreational benefits are estimated at \$759,200. Table 5 below provides a summary of project benefits.

TABLE 5
SUMMARY OF ANNUAL PROJECT BENEFITS

<u>TYPE</u>	<u>AMOUNT</u>
Shorefront Damage Reduction	\$ 207,400
Backshore Flood Damage Reduction	613,400
Recreation Benefit	<u>759,200</u>
TOTAL	\$1,580,000

The total first cost of construction is estimated to be \$18,675,000 as noted in Table 6 on Page 23. When this cost is annualized at 8-1/4% over a 50 year project life and estimated annual operation, maintenance and nourishment costs are added, the total annual project costs are estimated to be \$1,724,000. When the annual benefits are divided by the annual costs, the benefit-cost ratio is 0.92 to 1. Thus the project's economic justification test is just below unity.

For more information regarding the economic analysis see Appendix C.

TABLE 6
SUMMARY OF PROJECT COSTS

(A) Estimated Implementation Costs
(1993 Price Level)

- Scheduled Construction Costs		
Sandfill 659,100 cy x \$17.00/CY		\$11,205,000
West Floodwall, 2100 L.F.		770,000
East Floodwall, 3800 L.F.		1,474,000
Pump Station, 55 CFS		625,000
Real Estate Costs		<u>2,600,000</u>
	SUBTOTAL	\$16,674,000
Planning, Engineering & Design		1,167,000
Construction Management		<u>834,000</u>
	SUBTOTAL	\$18,675,000
- Unscheduled Construction Costs		
Sandfill/Renourishment		
(3,900 CY / year x 50 years x \$17 / CY)		<u>3,315,000</u>
- Total Estimated Implementation Cost	TOTAL	\$21,990,000

- Cost Sharing of Estimated Implementation Costs

	<u>Fed</u>	<u>Non-Fed</u>	<u>Totals</u>
Scheduled Construction Cost	\$12,139,000	\$6,536,000	\$18,675,000
Unscheduled Construction Cost	<u>2,155,000</u>	<u>1,160,000</u>	<u>3,315,000</u>
TOTALS	\$14,294,000	\$7,696,000	\$21,990,000

(B) Economic Data
(8-1/4%, 50 Year Life)

Annual Charges :	Annual cost (1)	\$1,724,000
	Annual benefit (2)	\$1,580,000

Benefit - Cost Ratio : 0.92 to 1

(C) Non-Federal Requirements :

LERRD (3)	Cash	
	Reimbursements	<u>\$7,696,000</u>
	TOTALS	\$7,696,000

Requirements for continuance of the study and the issue of how the Non-Federal sponsor will meet the obligations for sharing in the implementation costs of the project would be addressed during the feasibility phase.

(D) Cost Allocation

The proposed project has the principal purpose of reducing storm damage and flooding during coastal storms. The project would also provide recreational beach area. Therefore, the allocation of shared amounts is 65% Federal and 35% non-Federal.

(E) Federal Allocation to Date :

- Reconnaissance Study \$ 150,000

(F) Remaining Federal Requirements :

- Feasibility Phase \$ 270,000
- Implementation Costs, including P&S \$12,139,000

(G) Total Federal Investments : \$12,559,000

Notes :

(1) Annual Charges

- Scheduled Construction Costs : $\$18,675,000 \times .08409 = \$ 1,570,400$
(Int & Amort @ 8-1/4% for 50 years)
- Unscheduled Construction Costs : $3,900 \text{ cy / year} \times \$17 / \text{CY} = \$ 66,300$
(Nourishment is estimated on an average annual basis.
However, actual placement will be less frequent.)
- Operation & Maintenance Costs :
 $0.005 \times \$11,205,000 + 0.05 \times \$625,000 = \$ \underline{87,275}$

TOTAL \$ 1,723,975
SAY \$ 1,724,000

- (2) See Table 5 and Appendix C for the derivation of the annual benefits.
- (3) A non-Federal sponsor must assume the costs of lands, easements, rights of way and disposal (LERRD) for the project.

ENVIRONMENTAL CONCERNS

An assessment of the environmental impacts from the alternative plan closest to unity considered for Misquamicut Beach are summarized below.

Under the "no action" alternative, the shoreline of Misquamicut Beach would continue to be susceptible to damage from storms with a return period of five years or more. From an environmental standpoint the existing conditions and impacts will remain as is.

With a new beach berm and floodwalls in place, it is expected that long term environmental impacts will be minimal. According to the Rhode Island Coastal Resources Management Council, direct placement of beachfill is the preferred option for protection of the shorefront. There may be restrictions on the time of year that construction could be accomplished, however. It appears that avoidance of shoreline work from April to September would be desirable to minimize potential for impacts to birds and sea turtles that may be in the area. That constraint would also be advantageous from the standpoint of summertime recreational access.

Construction of the floodwalls and pump station may be subject to the same temporal constraint as outlined above, depending upon final site selection.

The Environmental Report for this study is contained in Appendix B.

ENVIRONMENTAL FINDINGS

Initial coordination with Federal, State and local agencies have revealed no outstanding or unresolvable environmental issues with the project identified herein. The reconnaissance investigations conclude that impacts to the species present at Misquamicut are expected to be minor. The piping plover, a Federal endangered species, is known to spend summer months nesting in the dunes that front Maschaug and Little Maschaug Ponds, however the construction window could be adjusted to avoid that time of year.

There are no identified prehistoric or underwater archeological resources that the identified project could impact. Floodproofing measures which may be performed on homes near the proposed project area could impact some historic resources. However, this is a preliminary investigation, and if this project proceeds to a further stage in the planning process, then formal comments will be requested from the Rhode Island Historical Preservation Commission. In a letter dated November 17, 1993, the Rhode Island Historical Preservation Commission concurred with some of these determinations.

CONCLUSIONS

The storm damages and coastal erosion problems at Misquamicut Beach in Westerly, Rhode Island have been studied along with backshore flooding and alternative plans to alleviate these concerns have been formulated. Based upon reconnaissance level engineering, economic and environmental study and review of the problem, the best solution has an economic justification just below unity. This solution has been developed with the support of the Town of Westerly and the New England Division, Corps of Engineers.

This study has been conducted under Section 103 of the Corps' Continuing Authorities Program. The provisions of Section 103 limit Federal spending on any one project to \$2,000,000. This figure includes authorization studies, pre-construction engineering, construction, and post-construction beach renourishment. The project alternative that has been identified as approaching economic justification would cost in excess of \$18 million initially, far in excess of what can be accomplished under the authority of Section 103.

RECOMMENDATIONS

Only one alternative was found to approach economic justification with a cost-benefit just below unity. The scope of that alternative far exceeds that which is authorized under Section 103 Authority. I therefore recommend no further Corps of Engineers involvement in providing storm and flood damage reduction measures under Section 103 Authority.

20 JANUARY 1994

Date

Brink P. Miller

Brink P. Miller
Colonel, Corps of Engineers
Division Engineer

ACKNOWLEDGEMENTS

The New England Division of the U.S. Army Corps of Engineers prepared this report under the direction of Colonel Brink P. Miller, Division Engineer. It was prepared under the supervision of Mr. John T. Smith, Chief, Coastal Development Branch, Mr. Paul E. Pronovost, Chief, Plan Formulation Division and Mr. Joseph L. Ignazio, Director of Planning.

Members of the Study Team include:

- Ms. Karen Umbrell - Economic Analysis
- Mr. Marc Paiva - Historic Properties
- Ms. Cathy Demos - Environmental Considerations
- Mr. Bob Meader - Coastal Engineering
- Ms. Laura Fraser - Geotechnical Engineering
- Ms. Rose Schmidt - Geotechnical Engineering
- Mr. Patrick Tornifoglio - Cost Engineering
- Mr. Townsend Barker - Hydrologic and Hydraulic Analysis
- Mr. Mark Geib - Hydrologic and Hydraulic Analysis
- Mr. Mike Walsh - Structural Engineering
- Mr. Kenneth Paton - Mechanical Engineering
- Ms. Jenny Tan - Civil Engineering
- Mr. Ed Fallon - Real Estate
- Ms. Maureen McCabe - Real Estate
- Mr. David Larsen - Study Manager

This report was prepared for publication by Ms. Kristina Reitz and Mr. Edward Bradley.

Special thanks are extended to the Planning and Zoning and Engineering Offices of the Town of Westerly, the Rhode Island Coastal Resources Management Council, the Rhode Island Department of Environmental Management and the University of Rhode Island Departments of Ocean Engineering and Geology, all of whom made important contributions during the preparation of this report.

APPENDIX A
HYDROLOGIC & HYDRAULIC ANALYSIS

WESTERLY RHODE ISLAND
TOWN OF MISQUAMICUT
RECONNAISSANCE REPORT FOR
COASTAL FLOOD PROTECTION

HYDROLOGIC AND HYDRAULIC ANALYSIS

BY
HYDROLOGIC ENGINEERING AND
HYDRAULICS AND WATER QUALITY BRANCHES
WATER CONTROL DIVISION
ENGINEERING DIRECTORATE

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASSACHUSETTS 02254-9149

NOVEMBER 1993

WESTERLY RHODE ISLAND
TOWN OF MISQUAMICUT
RECONNAISSANCE REPORT FOR
COASTAL FLOOD PROTECTION

HYDROLOGIC AND HYDRAULIC ANALYSIS

TABLE OF CONTENTS

<u>Paragraph</u>	<u>Subject</u>	<u>Page</u>
1	PURPOSE AND BACKGROUND	1
2	GENERAL DESCRIPTION	1
3	FLOOD HISTORY	
	a. Hurricanes	3
	b. Northeasters	3
	c. December 1992 Storm	3
4	FLOOD PLAIN ZONES	4
5	OCEAN STILLWATER FREQUENCIES	4
6	FLOOD INSURANCE STUDIES	4
7	INTERIOR FLOOD ANALYSIS	
	a. General	5
	b. UNET Modeling	6
	(1) General	6
	(2) Model Development	6
	(3) Results	6
	c. Beach/Dune Overtopping	8
	d. Flood Stage Frequencies	9
	(1) Zone 1	9
	(2) Zone 2	9
	(3) Zone 3	9
8	FLOOD CONTROL ALTERNATIVES	
	a. General	9
	b. Beach/Dune System	10
	c. Inlet Control at Weekapaug Breachway	10
9	SUMMARY	10

LIST OF FIGURES

<u>Figure</u>		<u>Page</u>
1	Flood Control Alternatives	2

LIST OF PLATES

<u>Plate</u>	<u>Description</u>
1	Westerly Recon Study, Watershed Area & Flood Plain Zones
2	Area Capacity Curves, Winnapaug Pond
3	Tide Curves, Hurricanes of September 1938 & August 1954
4	Tidal Flood Survey, Westerly to South Kingston, RI, Base Map
5	Tidal Flood Profile, Westerly to South Kingston, RI, Base Map
6	New London, CT, Tidal Flood Stage-Frequency Curve
7	Flood Stage Frequencies - Zone 1
8	Existing and Modified (10-year design) Flood Stage Frequencies - Zone 2
9	Existing and Modified (25-year design) Flood Stage Frequencies - Zone 2
10	Existing and Modified (50-year design) Flood Stage Frequencies - Zone 2
11	Existing and Modified (100-year design) Flood Stage Frequencies - Zone 2
12	Existing and Modified Flood Stage Frequencies -Zone 3

WESTERLY RHODE ISLAND
VILLAGE OF MISQUAMICUT
RECONNAISSANCE REPORT FOR
COASTAL FLOOD PROTECTION

HYDROLOGIC AND HYDRAULIC ANALYSIS

1. PURPOSE AND BACKGROUND

This reconnaissance report presents results of studies concerning coastal flooding conditions at Westerly, Rhode Island--specifically the village of Misquamicut and the Winnapaug Pond area. These studies found that any plan to control flooding at Misquamicut must include a dike or wall along the ocean, and on the west end of town near Little Mashapaug Pond (figure 1). Additionally, it was found that large amounts of flow enter through the breachway at the west end of Winnapaug Pond. Consequently, any plan to provide more than minimal flood protection to Misquamicut must either control flows through the breachway, or provide a dike between Misquamicut and Winnapaug Pond. Finally, means to control interior drainage during flood events should be considered.

The study was performed under authority contained in Section 103 of the Rivers and Harbors Act of 1962, as amended. Flood conditions in the Misquamicut area are caused mainly by wave overtopping the beach area, high tidal inflows to Winnapaug Pond through the breachway, and, to a lesser extent, rainfall. After damage caused by the 11 December 1992 storm, reconnaissance studies were conducted to assess flooding problems and determine possible flood control alternatives. Included are general descriptions, sections on flood history, interior flood analysis, and flood control improvements.

2. GENERAL DESCRIPTION

The town of Westerly is located about 45 miles southwest of Providence on the south coast of Rhode Island. The area of concern in this investigation is the town and beach in Misquamicut, RI. The study area includes about 3 miles of beach fronting the village of Misquamicut and Winnapaug Pond. There is a breachway at the eastern end of the study area that allows tidal exchange between the pond and the ocean. Winnapaug Pond receives freshwater runoff from about 4.7 square miles of drainage area. Plate 1 shows the study area and Winnapaug Pond's drainage area. An area capacity relationship of the pond (plate 2) shows that, at mean high tide elevation of about 1.0 foot NGVD, the pond has a surface area of about 700 acres.

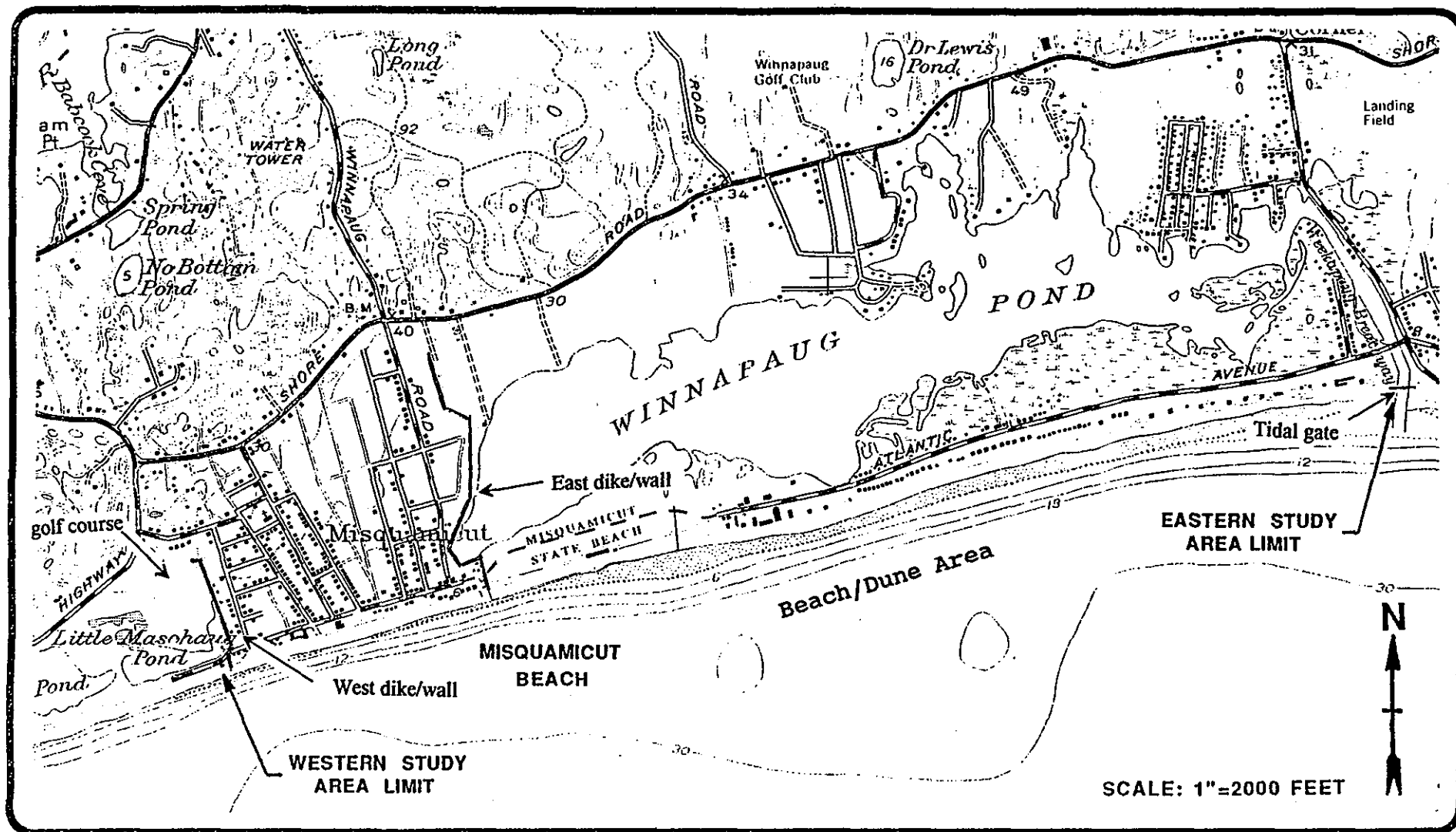


FIGURE 1

FLOOD CONTROL ALTERNATIVES

MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND



US Army Corps
of Engineers
New England Division

3. FLOOD HISTORY

a. Hurricanes. Along the coastal lowlands at Westerly, the most severe flooding is caused by hurricanes. These tropical storms are characterized by low barometric pressure, winds in excess of 75 miles per hour, torrential rain, and huge waves. Although there are historical records of storms which may have caused worse flooding, the September 1938 and August 1954 hurricanes caused the most severe flooding at Westerly, for which good records of flood levels exist. Both storms caused extensive coastal damage. The Westerly Flood Insurance Study reports that the 1938 hurricane destroyed all structures on the lower elevations of the Winnapaug Pond barrier beach, and probably on all other low lying areas along the coast. Hurricane "Carol," in 1954, also washed away many shorefront homes, and damaged dunes protecting inland areas along the coast. High watermarks indicate stillwater ocean levels of about 11.9 feet NGVD during the 1938 hurricane, and 11.5 feet during the 1954 event. Tide curves for these two severe hurricanes are shown on plate 3.

b. Northeasters. In New England, coastal storms that have strong onshore winds but are not hurricanes, are commonly referred to as "northeasters." These extratropical low pressure systems do not develop the high winds and torrential rains characteristic of hurricanes. However, northeasters move more slowly, and can even stall in one place, exposing the shore to continual wave attack and storm surge over several tide cycles.

c. December 1992 Storm. In mid-December 1992, a powerful northeaster hit southern New England. Highest tides at New London during this storm were recorded on 11 December at elevation 5.4 feet NGVD--equivalent to a 5-year event based on statistical analysis of the long term New London gage record. This storm also produced flood levels at Newport, Rhode Island, and Woods Hole, Massachusetts, which were at the 5-year level. Consequently, flooding produced by this northeaster was considered a 5-year event for the section of coast including Westerly.

No high watermarks were officially recorded for the December 1992 storm; however, in September 1993, NED personnel interviewed residents at Misquamicut about the flooding. The owner of the Sea Shell Motel on Winnapaug Road said she did not have first floor flooding in December 1992, nor has she ever experienced such during her 18 years of motel ownership. A resident of Newland Motel on Winnapaug road (across the street from the Sea Shell) said several high tides came in during the December 1992 northeaster. The parking lot was flooded, but not the first floor. Using a

2-foot contour interval map supplied by the town of Westerly, and the above reports of flooding, it appears that stillwater levels in Winnapaug Pond and Misquamicut were about elevation 6 feet NGVD during the 1992 northeaster.

4. FLOOD PLAIN ZONES

For purposes of this study, the area was divided into three flood plain zones, as shown in plate 1. Zone 1 is the beach area extending from the breachway westerly about three miles to the western edge of the village of Misquamicut. Zone 2 is the interior area consisting of the village of Misquamicut and peripheral areas of Winnapaug Pond. Zone 3, the last area, is generally along the top of dune/beach, behind zone 1, and includes those areas affected by wave overtopping waters that flow into zone 2.

5. OCEAN STILLWATER FREQUENCIES

There are no tide gages at Westerly. Consequently, ocean stillwater elevation frequencies were estimated from plots in "Tidal Flood Profiles, New England Coastline," prepared by NED in September 1988. These profiles give 1, 10, 50, and 100-year open coastal flood levels for Westerly based on stage-frequency curves developed for New London, Connecticut, and Newport, Rhode Island, and high watermarks observed during the 1938 and 1954 hurricanes (plates 4 and 5). Effects of additional years of record were checked by recalculating New London's stage-frequency curve using the HEC-FFA Flood Frequency Analysis program (May 1992). New London was used because it is the closest recording tide gage to Westerly. Results showed only an insignificant change; consequently, values in "Tidal Flood Profiles" for Westerly were considered still valid. Plate 6 shows the updated stage-frequency curve for New London. A correlation between Westerly and New London was developed to permit stillwater level estimations for events between the 1 and 10-year, and 10 and 25-year frequencies. Finally, the Westerly curve was adjusted at its upper end to match high watermarks observed during the 1954 and 1938 hurricanes, which are considered the 50 and 100-year events, respectively. Results are presented in plate 7.

6. FLOOD INSURANCE STUDIES

Stone and Webster Engineering Corporation prepared a flood insurance study (FIS) for the Federal Emergency Management Agency for the town of Westerly in February 1986. Stillwater ocean levels were computed for the 10, 50, and 100-year events. Table 1 compares FIS stillwater levels with those used by NED in this study.

TABLE 1

COMPARISON OF COMPUTED OCEAN STILLWATER ELEVATIONS

<u>Event</u> (year)	<u>FIS Level</u> (ft, NGVD)	<u>NED Level</u> (ft, NGVD)
100	11.9	11.8
50	10.5	11.5
10	7.8	8.0

The 10 and 100-year FIS levels agree with those developed by the Corps. However, NED's 50-year stillwater is a foot higher than that in the FIS. NED used the 1938 and 1954 hurricanes as the 100 and 50-year events, respectively. This gives the NED stage-frequency curve (plate 7) a bend at one end. Apparently, Stone and Webster computed a relatively smooth curve for the full range of ocean stillwater frequencies; a smooth curve gives a 50-year elevation of about 10.5 feet NGVD. The 1-foot difference in 50-year stillwater elevations between NED and the FIS is not enough to change overall damage frequency estimations significantly. Furthermore, we have confidence in the historic data used to compute NED's 50-year elevation. Consequently, we did not try to resolve the difference between the two stage-frequency curves, but stayed with NED's.

7. INTERIOR FLOOD ANALYSIS

a. General. Flooding along Misquamicut is complex and made up from several sources. First, substantial wave overtopping occurs along the beach during severe coastal storms or hurricanes. Second, the breachway permits significant tidal inflow to Winnapaug Pond, which may result in total flooding of the interior, depending on the duration of the storm event. Last, and considerably less significant, is freshwater rainfall runoff coincident with high tide events. This can contribute to flooding, particularly in areas with undersized storm drains; however, it is minor compared to tidal inflows.

Flow through the breachway was simulated using the UNET computer model. Wave overtopping was estimated based on wave runup data, historic events, and the development of a simple triangular wave overtopping hydrograph. Using results of UNET modelling and wave overtopping analysis, flood-stage frequency curves were developed for Winnapaug Pond and Misquamicut, and the beach/dune area.

b. UNET Modeling

(1) General. UNET is an unsteady flow computer model developed by Robert L. Barkau, Ph.D. and supported by the Corps of Engineers Hydrologic Engineering Center (HEC). UNET simulates one-dimensional unsteady flow through a full network of open channels (see draft User's Manual, dated May 1991). The model is considered applicable for this analysis as it simulates tidal inflow/outflow from the extensive pond area, with consideration for timing and storage requirements.

(2) Model Development. A UNET model was developed for Winnapaug Pond and breachway. Cross sections were developed from available mapping, including the USGS 1:24,000 quad sheets and mapping developed during the 1963 interim report prepared by the Corps. The first cross section in the model was taken through Winnapaug Pond at a point opposite the village of Misquamicut. Additional sections, input an average distance of about 700 feet apart, proceeded through the pond and breachway, ending at the ocean. A section was also input, representing the Atlantic Avenue bridge over the breachway. The section developed at the bridge was based on detailed surveys of the bridge geometry and channel width. A token starting flow was entered along with a flow representing runoff from the 4.7-square mile drainage area. At the last cross section (ocean section), a stage hydrograph was input as the downstream boundary condition representing the controlling ocean tide levels. Several days of tide cycles were input on the stage hydrograph, preceding a storm, and run in the model to "stabilize" the pond level before simulating a storm hydrograph. The flow convention in the model is positive when flow exits the pond (i.e., flows into the ocean), and negative when ocean waters enter the pond. Several storm events were simulated including the 21 September 1938 and 31 August 1954 hurricanes, the recent 11 December 1992 northeaster, and "synthetic" events. Tidal plots for the September 1938 and August 1954 hurricanes, obtained from the 1963 interim report, are shown on plate 3. These, and other tidal flood levels, were based on analysis of recorded data mostly from records at the New London NOS gage.

(3) Results. Results of the UNET analysis showed that large amounts of flow enter through the breachway; however, breachway flows alone cannot account for high water levels observed in Winnapaug Pond during some storm events. Therefore, wave overtopping of the beach has a major effect on Winnapaug Pond levels during large storms. Analysis of a recurrence of the September 1938 hurricane indicated pond levels would be about elevation 7.3 feet NGVD, with

flows only through the breachway (i.e., no wave overtopping). We know, however, that interior levels (from high watermarks) reached elevation 11.8 feet NGVD--the ocean stillwater level. We also note that the breachway was not constructed in 1938. This shows that major wave overtopping of the beach occurred during the 1938 hurricane, and this overtopping was enough to raise Winnapaug Pond to the ocean level without benefit of the existing breachway. However, the UNET modelling shows that if a dune sufficient to prevent wave overtopping were in place during a recurrence of the 1938 hurricane, the breachway would allow enough flow to cause a major rise in the level of Winnapaug Pond.

In addition, "synthetic" hurricane type storms (i.e., one storm tide) with ocean stillwater levels of 8.0 and 6.8 feet NGVD were analyzed. These storm events would represent 10 and 5-year flood frequency stillwater levels (see Misquamicut ocean stillwater frequency curve, plate 7). Results of UNET analysis indicate that Winnapaug Pond levels would be 6.6 and 5.5 feet NGVD for the 10 and 5-year flood events, respectively. These are about 1.4 feet lower than the peak ocean stillwater elevation for these events. Again, the studies show that when no wave overtopping is assumed, only flow through the breachway, the level in Winnapaug Pond can rise significantly, but will not reach ocean stillwater levels for the 5 and 10-year events.

Northeaster type storms were also analyzed. These storms differ from hurricanes as they are often of much longer duration and can last over several high tide events. The 11 December 1992 event was simulated with a stillwater hydrograph, developed from analysis of New London data. The ocean stillwater level for this event was determined to be elevation 6.8 feet NGVD, or about a 5-year tidal event. Results of this analysis indicate that while the ocean stillwater level was 6.8 feet NGVD, the interior pond level was found to be 6.2 feet NGVD. This agrees with residents' reports of flood levels during the storm (paragraph 3c). Similarly, a "synthetic" 10-year northeaster-type storm was analyzed, and showed no difference between ocean stillwater levels and the computed interior pond level; both were approximately 8 feet NGVD.

These analyses indicate a significant difference is maintained between ocean and pond levels for a one-tide storm event such as a hurricane, while prolonged storms like northeasters result in lesser differences in elevations. Ocean and pond levels equalize at about a 10-year northeaster event, because pond levels "build up" during the several high tides preceding the major portion of the storm. Since the pond cannot totally drain, interior and ocean levels equalize during the peak of the storm.

c. Beach/Dune Overtopping. Historically, major wave overtopping has occurred along the beach front at Misquamicut. Analysis, based on available mapping and wave runup data, indicate that overtopping begins at about a 10-year event, and major overtopping occurs for storms greater than that.

The limited topographic mapping available indicates a large section of the beach front has a top elevation greater than 10 but less than 20 feet NGVD. The only section where detailed mapping is available (about 4,000 feet of beach fronting Misquamicut), indicates that all top of beach frontage is above elevation 10, with most at elevation 12 feet NGVD or greater. Based on this, and wave runup information provided by the Coastal Engineering Branch of Design Division, it appears that no major overtopping would occur at about a 20 percent chance (5-year) flood event. Top of runup for this event is elevation 9.0 feet NGVD, while top of runup for a 10-year event is elevation 11.6 feet NGVD. This indicates overtopping would occur during a 10-year event since a large portion of the top of beach is between 10 and 12 feet NGVD. Also, major overtopping would be occurring at a 100-year event, as can be seen with the top of runup at over 15 feet NGVD.

An attempt was made to estimate the magnitude of overtopping for the 100 and 10-year events. UNET analysis results for the recurring 1938 hurricane were reviewed, and showed an interior pond level of elevation 7 feet NGVD, resulting from flow through only the breachway. Experienced levels within the pond were at elevation 11.8 feet NGVD (same as stillwater). Assuming wave overtopping does not cause pond levels to significantly exceed ocean stillwater levels (pond and ocean levels were the same in 1938 and 1954), we determined the required volume of overtopping to increase the pond level from elevation 7 to 11.8 feet NGVD. This volume, 3,400 acre-feet (see area-capacity curve on plate 2), was assumed to occur over three hours during the storm's peak. A triangular hydrograph, with a duration of three hours and volume of 3,400 acre-feet, would have a peak discharge of 27,400 cfs. Evenly distributing this peak rate over approximately 12,000 feet of beach, gives a unit overtopping rate of 2.3 cfs/foot. This rate of overtopping was compared to overtopping rates computed by the Coastal Engineering Research Council (reference FDM #2, Hydrology and Hydraulics Flood Damage Reduction Project, Saugus River and Tributaries, Massachusetts, 1993, Appendix III) through detailed studies along Revere Beach. CERC's maximum rates for a 100-year storm, and no beach in front of the Revere seawall, ranged from 2.4, to 3.0 cfs/foot of wall. Conditions at Revere's seawall are not completely the same as those at Westerly's

beach; however, there are enough similarities that our computed 2.3 cfs/foot peak rate of overtopping for Misquamicut appears reasonable.

This same analysis was conducted for a 10-year event, using the same assumptions, and a unit rate of overtopping of 0.9 cfs/foot was determined. Again, this seems reasonable, considering the small difference between top of the beach and wave runup height.

d. Flood Stage Frequencies. Westerly's geographic characteristics--open ocean, Winnapaug Pond, and a beach area experiencing wave runup and overtopping--mean that a single stage-frequency curve cannot be developed that would apply to all areas. Consequently, the study area was divided into three zones, and separate frequency curves were developed for each.

(1) Zone 1. This zone is located along the beach at Misquamicut (see plate 1). A curve, as described in paragraph 5, was developed and is shown on plate 7.

(2) Zone 2. This interior curve is for areas around Winnapaug Pond and within the village of Misquamicut. Development of the curve was aided by UNET analysis results, together with surveyed high watermarks for historic events (1938 and 1954). The adopted curve is shown on plates 8 through 11.

(3) Zone 3. This zone, along the beach/dune area, is subject to wave overtopping. Stage frequencies for this zone are presented as depth of flow over top of the beach/dune, due to wave overtopping. The relationship was developed by using the estimated maximum overtopping rates (as discussed in paragraph 7c), and an assumed velocity of 2 feet per second to get the depth of flow of water over the land during peak overtopping. The adopted stage-frequency relationship for zone 3 is shown on plate 12. If further study is undertaken, more detailed analysis of this and other zones will be required.

8. FLOOD CONTROL ALTERNATIVES

a. General. Flood damage studies have indicated that the principal damage area within the study limits is the village of Misquamicut. Analysis has indicated that flooding to this area is caused by (1) high Winnapaug Pond levels, (2) overtopping of the fronting beach, and (3) waters entering Misquamicut from the west, through Little Mashapaug Pond. Flood control improvements to protect this area must include a western dike; beach, dune or shorefront protection; and a means to control Winnapaug Pond levels or prevent pond water from entering Misquamicut. A sketch of possible alternatives is shown on figure 1.

b. Beach/Dune System. This improvement would be to prevent wave overtopping from entering Misquamicut. This system would be accompanied by a western dike, and an eastern dike or a control structure to limit Winnapaug Pond flood levels. Using eastern and western dikes in combination with the beach/dune system may require an interior drainage pumping station and pressure conduit. This alternative would be analyzed in detail during feasibility studies to assure the two dikes would not increase interior flood levels in the event the beach/dune system design is exceeded.

Modified stage frequencies, determined for this alternative for various levels of design, are shown on plates 8 through 11. In each case it was assumed that, when waves overtopped the constructed beach/dune system (i.e., when the design level of the beach is exceeded), interior flooding quickly increased to levels that would have occurred under preconstruction conditions.

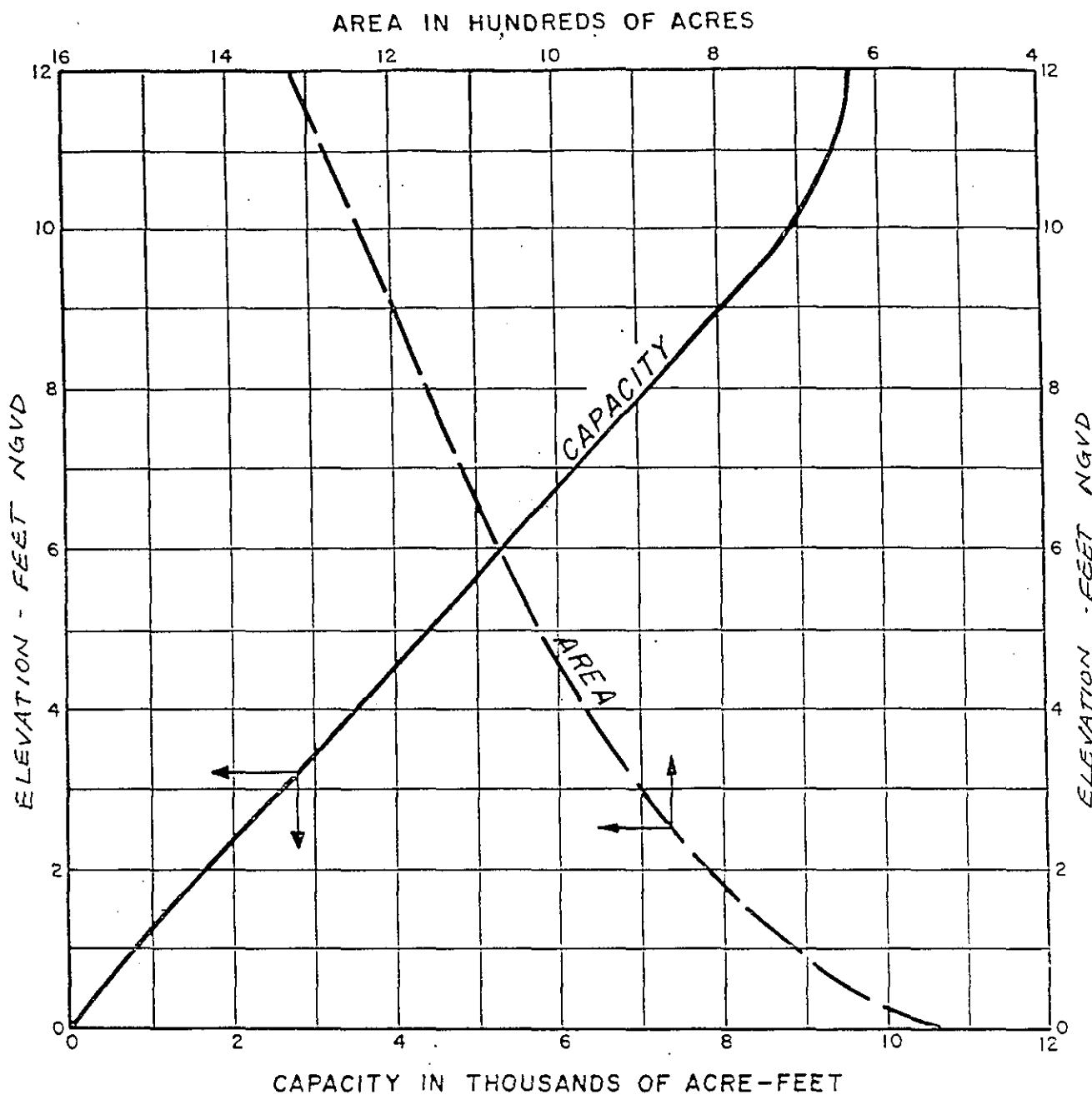
c. Inlet Control at Weekapaug Breachway. An alternative to the eastern dike, and a means to provide protection along the entire perimeter of Winnapaug Pond, is to control tidal inflow at the Weekapaug breachway. There is sufficient storage capacity in the pond to safely store interior rainfall runoff during storm tides, provided a control structure is closed before pond elevations exceed 2 to 3 feet NGVD. Such a structure would prevent flood damages to all interior areas until the combination of ocean level and wave runup exceeded beach/dune design levels. This alternative would still require a western dike.

9. SUMMARY

Flooding conditions for the study area were evaluated at a reconnaissance level of detail. These results can be used to screen alternatives and determine if feasibility studies are warranted.

These studies found that any plan to control flooding at Misquamicut must include a dike or wall along the ocean and on the west end of town near Little Mashapaug Pond. Additionally, because large amounts of flow enter through the breachway at the east end of Winnapaug Pond, any plan to provide more than minimal flood protection to Misquamicut must either control flows through the breachway, or provide a dike between Misquamicut and Winnapaug Pond. Finally, means to control interior drainage during flood events should be considered.

Results presented in this report can be further refined during feasibility studies to develop more detailed plans for flood control.

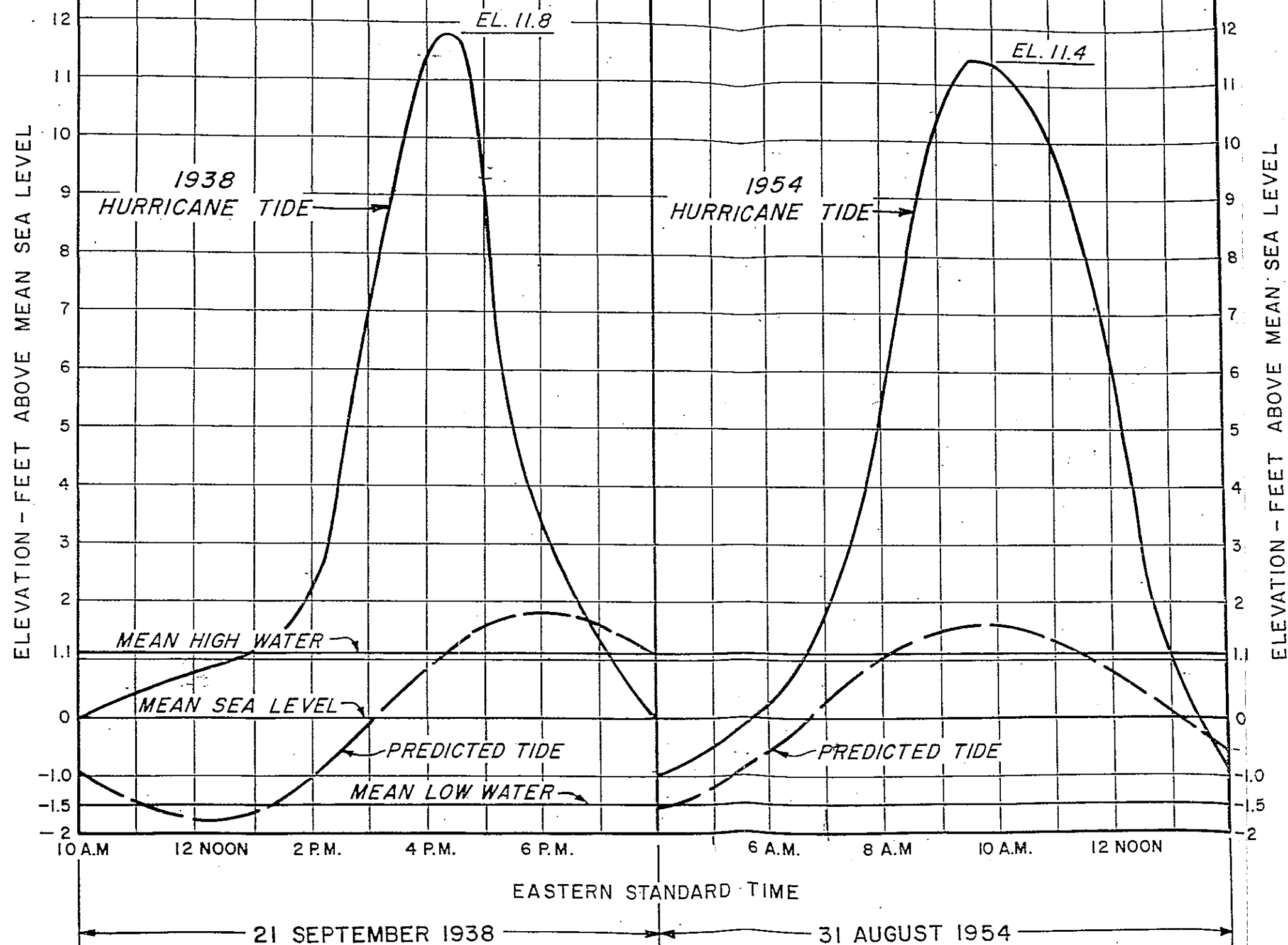


NOTE:

INCLUDES WINNAPAUG POND.

WESTERLY, R.I.
AREA AND CAPACITY CURVES

U.S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS. NOV. 1962
SCALE AS SHOWN



NOTE:

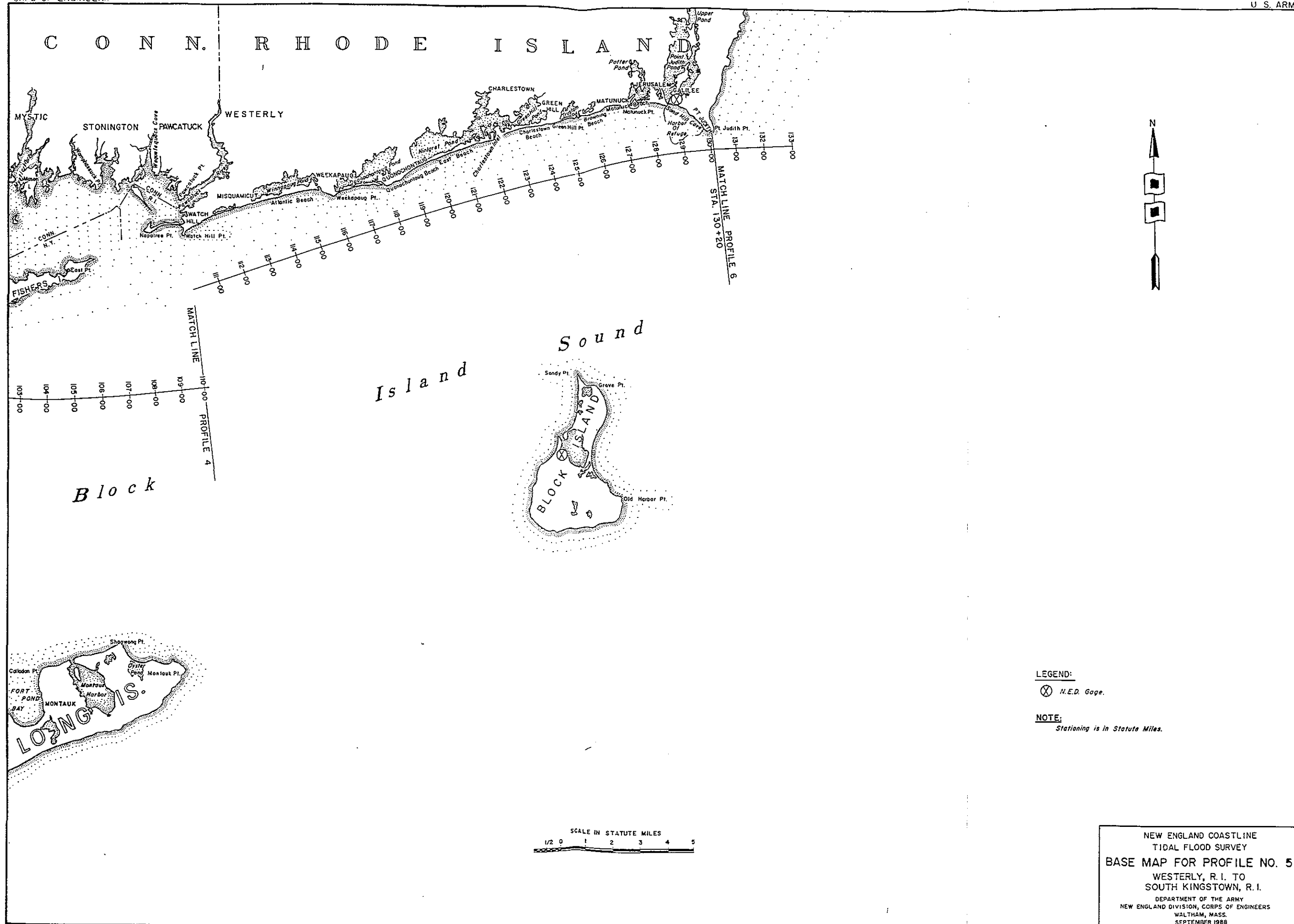
Hurricane of September 21, 1938 tide curve based on high water marks at Misquamicut and hurricane tide at Newport, Rhode Island stage related to Misquamicut.

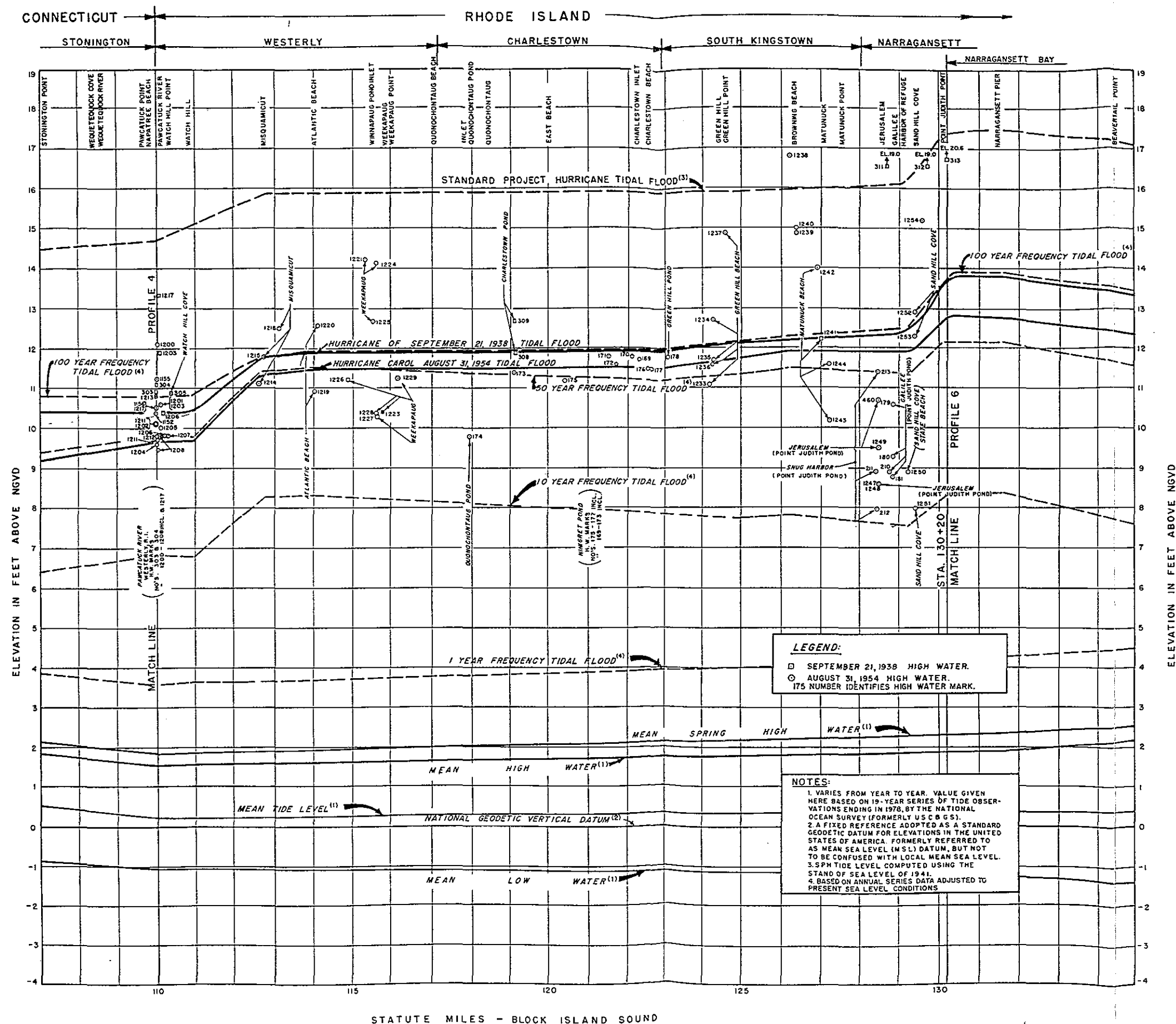
NOTE:

Hurricane Carol, August 31, 1954 tide curve based on high water marks at Misquamicut and hurricane tide at Newport, Rhode Island stage related to Misquamicut.

WESTERLY, R.I.
MISQUAMICUT
TIDE CURVES
HURRICANES-1938 & 1954

U. S. ARMY ENGINEER DIVISION, NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS. NOV. 1962



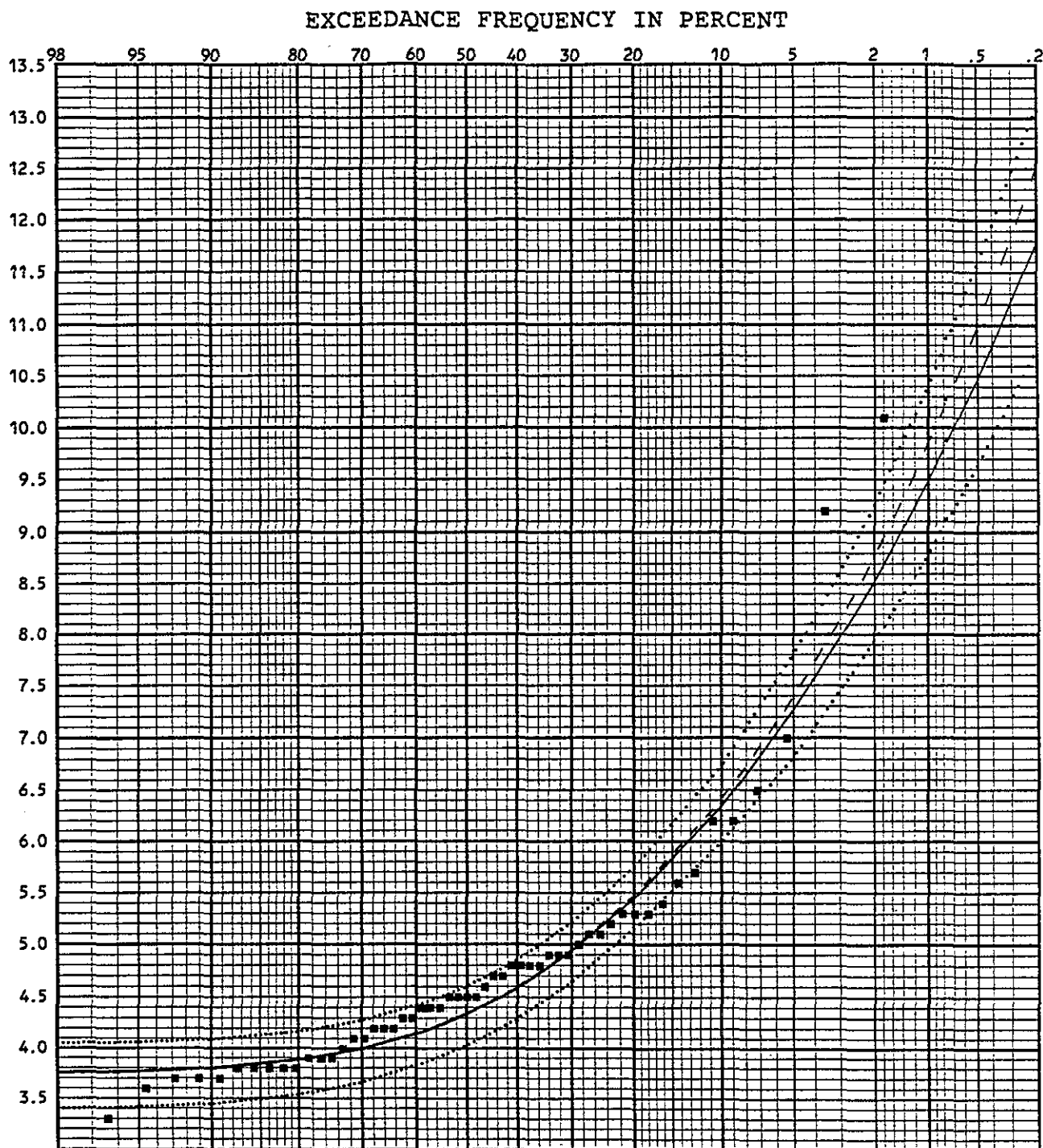


NEW ENGLAND COASTLINE
TIDAL FLOOD SURVEY
TIDAL FLOOD PROFILE NO. 5
WESTERLY, R.I. TO
SOUTH KINGSTOWN, R.I.
DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.
SEPTEMBER 1980

E
L
E
V

I
N

F
E
E
T

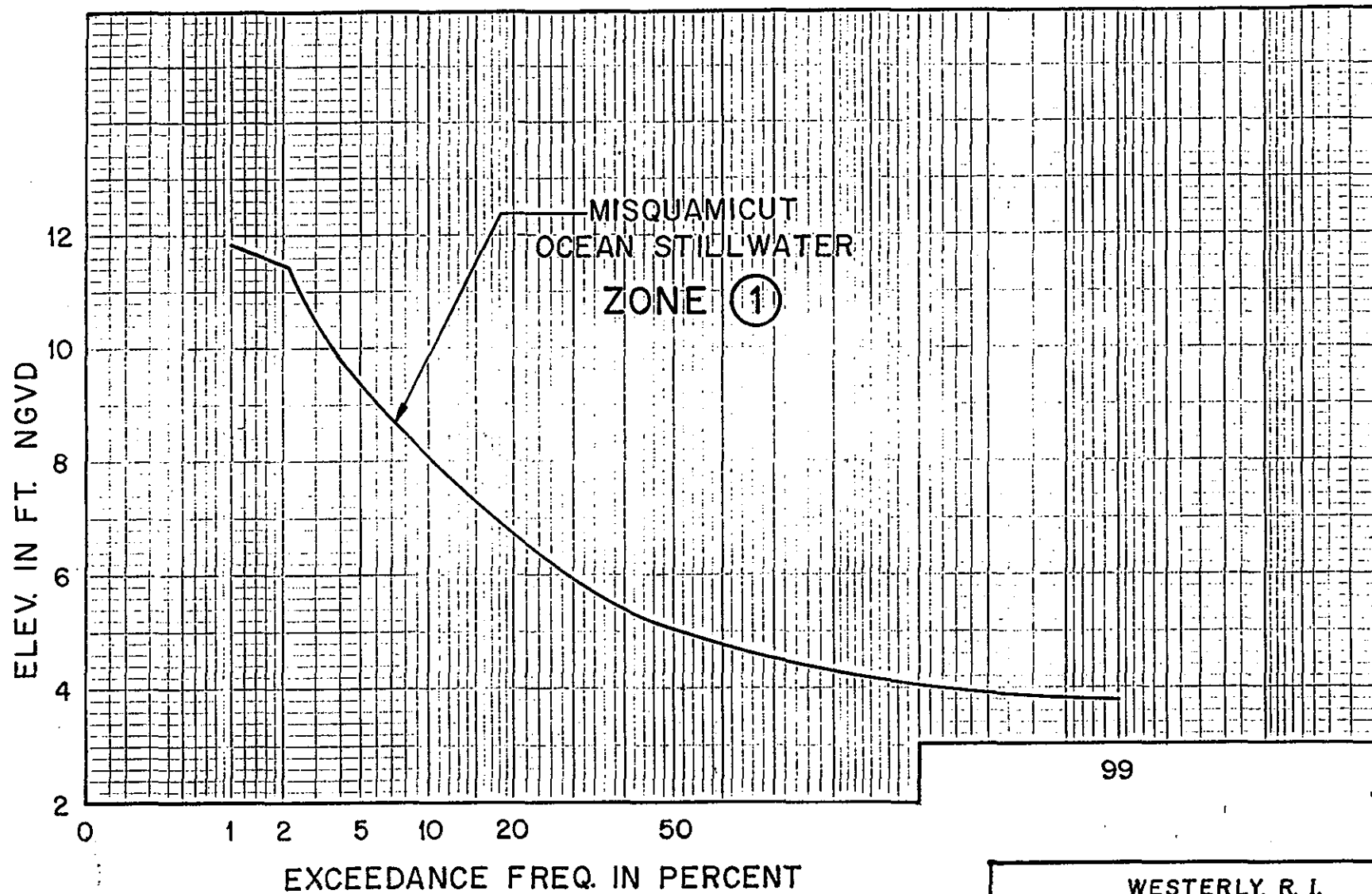


- Elev Frequency (without Exp. Prob.)
- Elev Frequency (with Exp. Prob.)
- Weibull Plotting Positions
- 5% and 95% Confidence Limits

FREQUENCY STATISTICS

NO TRANSFORM OF ELEV, FEET		NUMBER OF EVENTS	
MEAN	4.8	HISTORIC EVENTS	0
STANDARD DEV	1.2	HIGH OUTLIERS	2
SKEW	2.4234	LOW OUTLIERS	0
REGIONAL SKEW	2.4234	ZERO OR MISSING	0
ADOPTED SKEW	2.4234	SYSTEMATIC EVENTS	55
		HISTORIC PERIOD(1939-1993)	55

NEW LONDON, R.I.
STAGE-FREQUENCY CURVE
USGS GAGE AT NEW LONDON, R.
BASIN AREA = 4.70 SQ MI



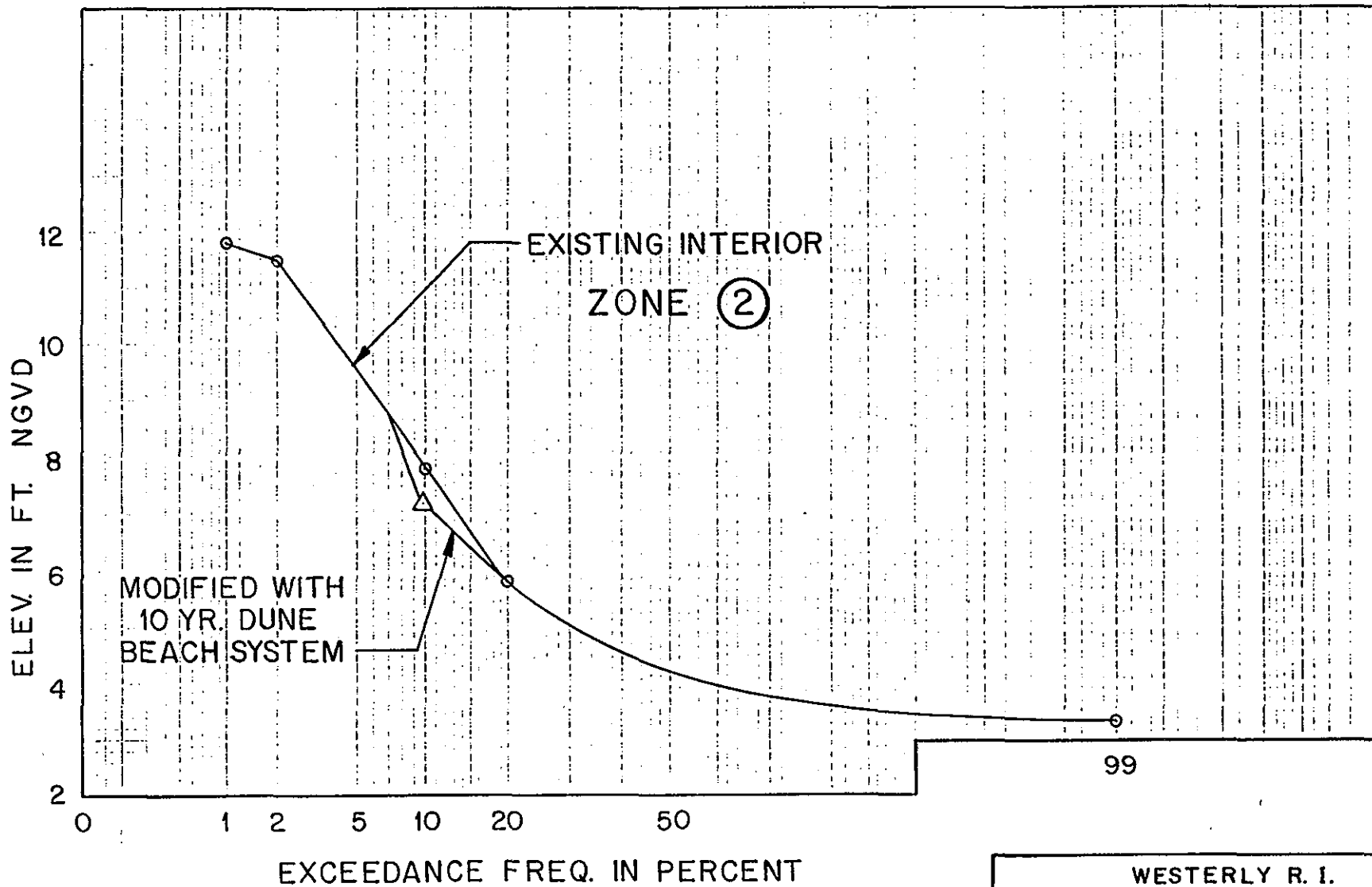
WESTERLY, R. I.

RECON. STUDY

STAGE FREQ. CURVES

HEB

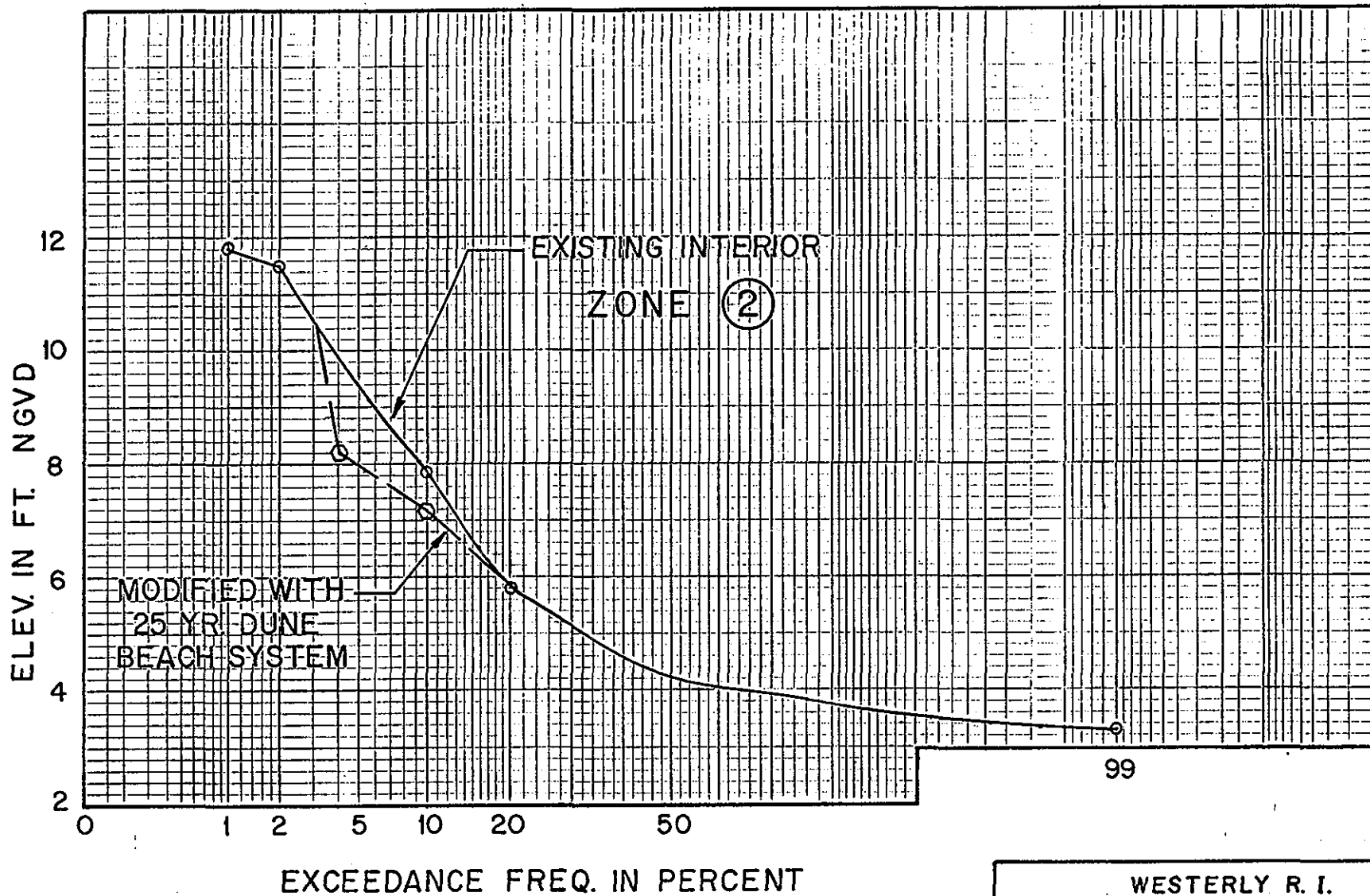
AUG. 93



WESTERLY R. I.
RECON. STUDY
STAGE FREQ. CURVES

HEB

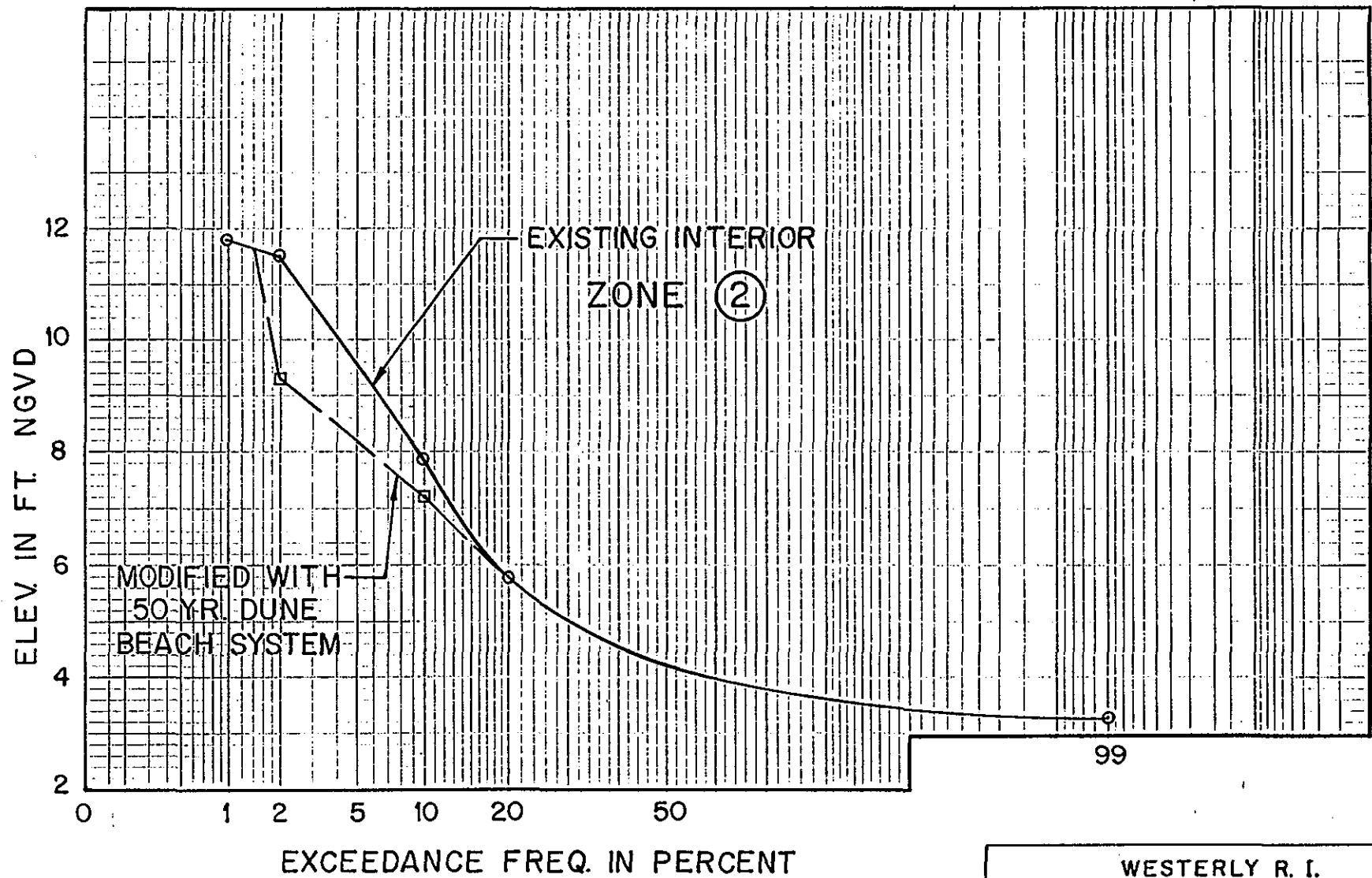
AUG. 93



WESTERLY R. I.
RECON. STUDY
STAGE FREQ. CURVES

HEB

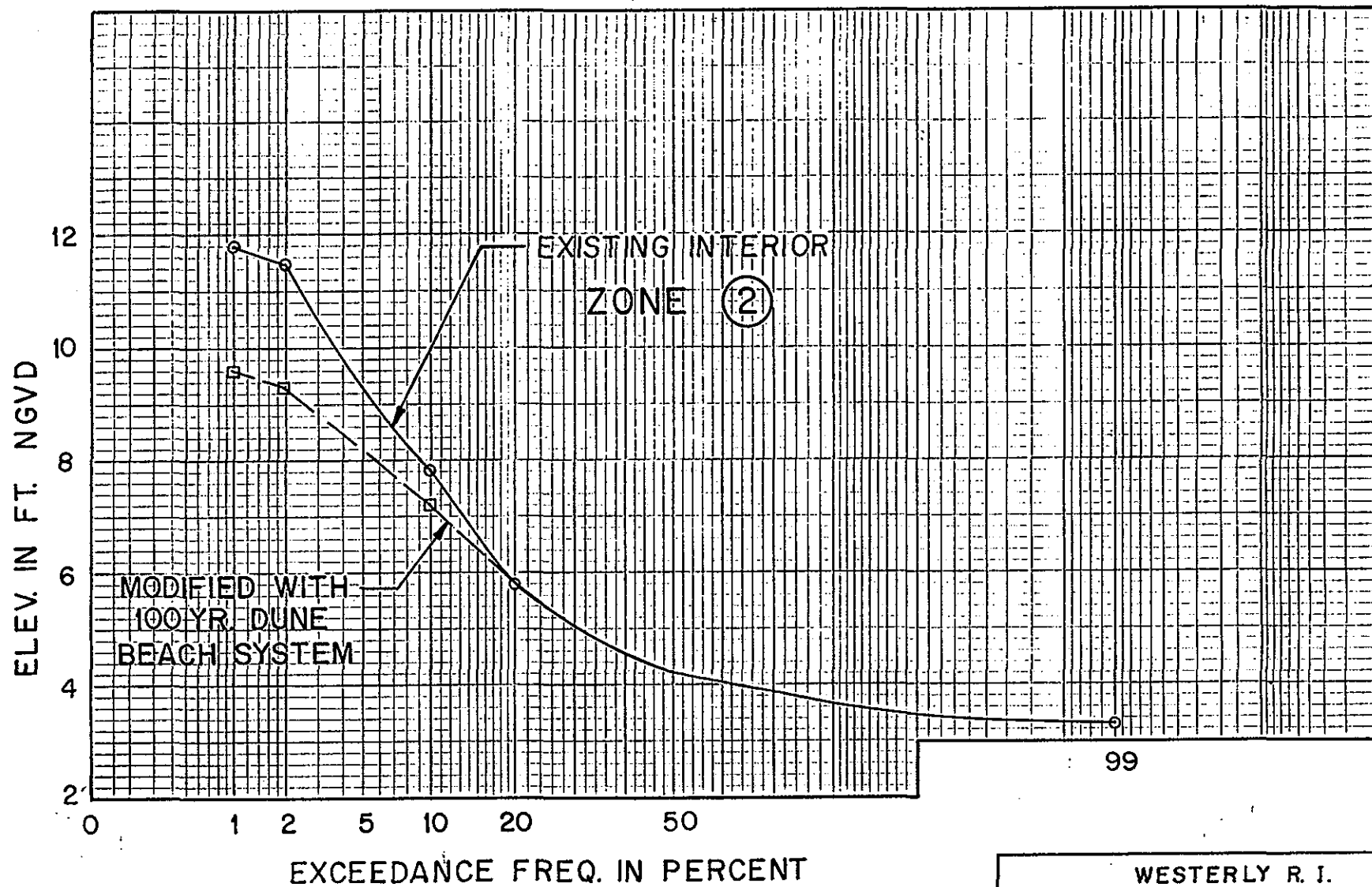
AUG. 93



WESTERLY R. I.
RECON. STUDY
STAGE FREQ. CURVES

HEB

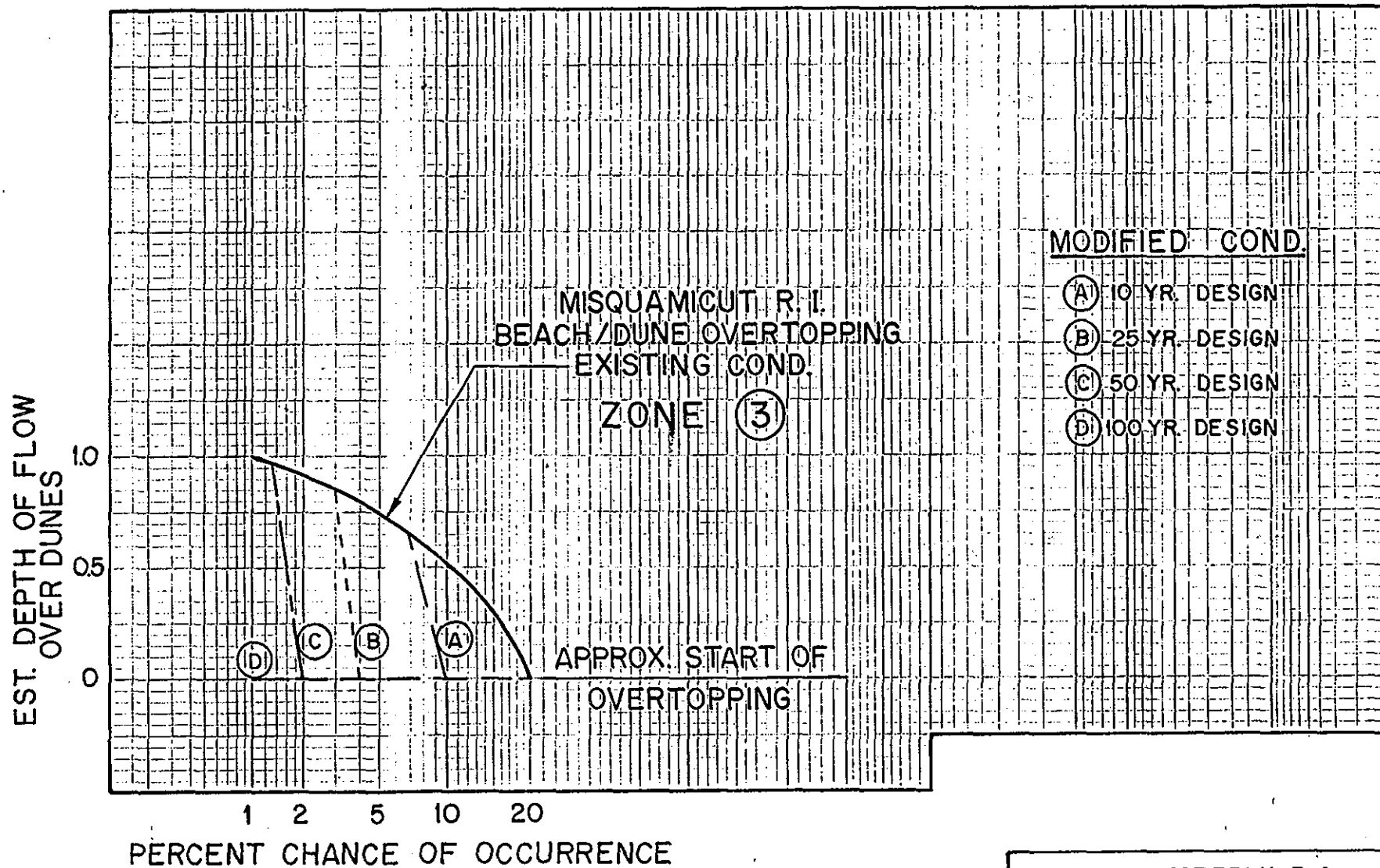
AUG. 93



WESTERLY R. I.
 RECON. STUDY
 STAGE FREQ. CURVES

HEB

AUG. 93



APPENDIX B

ENVIRONMENTAL RECONNAISSANCE REPORT

MISQUAMICUT BEACH
WESTERLY, RHODE ISLAND

SECTION 103
SHORE PROTECTION AND EROSION CONTROL STUDY

ENVIRONMENTAL REPORT

Prepared by:

Catherine J. Demos - Ecologist
&
Mark Paiva - Archaeologist

New England Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-0913

October 1993

TABLE OF CONTENTS

<u>Subject</u>	<u>Page Number</u>
I. ENVIRONMENTAL SETTING	
1. Introduction	1
2. History of Project	1
3. Water Quality and Tide Level/Range	1
4. Sediment Quality	1
5. Aquatic Resources	2
a. Eelgrass Beds	2
b. Shellfish (Molluscan and Crustacean)	2
c. Finfish	2
6. Terrestrial Resources	3
7. Endangered, Threatened, and Rare Species	3
8. Historical and Archaeological Resources	3
II. ENVIRONMENTAL CONSIDERATIONS	4
1. No Action Alternative	4
2. Beach Erosion and Flood Control Alternatives	4
a. Physical and Chemical Impacts	5
b. Biological Impacts	5
c. Endangered, Threatened, and Rare Species	6
d. Historical and Archaeological Impacts	6
3. Coordination	7
4. Recommendations	8
REFERENCES	9
APPENDIX (Coordination Letters)	

I. ENVIRONMENTAL SETTING

1. Introduction

The town of Westerly is located in the southwest corner of the State of Rhode Island adjacent to Block Island Sound. The Pawcatuck River separates the town of Westerly on the west from the State of Connecticut. An area of beach known as Misquamicut Beach, and the residential area behind it has experienced flood and storm damage. The east end of Misquamicut Beach is marked by the Weekapaug Breachway. This breachway opens into Winnapaug Pond which is located behind Misquamicut Beach. Commercial business areas are located to the east and west of the Misquamicut State Beach. To the west of Winnapaug Pond lies a low lying residential area and then Little Maschaug Pond (see Figure 1).

2. History of Project

The project area was studied by the Corps of Engineers for storm and flood damages in the late 1960's. The proposed project recommended dikes along the west end of Winnapaug Pond and the east end of Little Maschaug Pond. In addition, sandfill, revetement, and groins would be placed along Misquamicut Beach to protect businesses and homes along the shore. This project was never built and was eventually deauthorized in 1986.

3. Water Quality and Tide Level/Range

There is little, if any, heavy industry located in the Misquamicut area. There are, however, several golf courses which surround Little Maschaug Pond and Winnapaug Pond. Overall the water quality of the ponds is considered to be high. They are classified as an Outstanding National Resource (ONR), according to the State of Rhode Island, Division of Water Resources. The ponds are considered to have a substantial wildlife value.

The waters of Block Island Sound off the shores of Misquamicut Beach are rated SA. This is the highest water quality level and is considered to have good aesthetic, wildlife, and recreational value.

The mean tide level for Misquamicut Beach is 1.5 feet. The mean tidal range is 2.6 feet and the mean spring tidal range is 3.1 feet. Winnapaug Pond is connected to Block Island Sound by the Weekapaug Breachway. The level of the pond fluctuates with the tides and is particularly susceptible to storms. Although Little Maschaug Pond is not connected to Block Island Sound, it does receive overtopping water from storms in the Sound. This fills the pond which spills into the residential area to the east and the golf course to the north.

4. Sediment Quality

Misquamicut Beach is a barrier beach composed of fine to coarse grained sand with some areas containing pebbles. Littoral drift carries sand from the Pawtucket River/Watch Hill area from the west along the shore to the east. Some of this sand is deposited along Misquamicut Beach.

The tidal flows from the Weekapaug Breachway into Winnapaug Pond influences bottom composition (DeLancey and Ganz, 1981). Bottom composition ranges from hard-packed sand and gravel to soft organic mud. The southern shore along the barrier beach and the eastern deltas are exclusively sand. The western and central parts of the pond have portions of mud stabilized by dense eelgrass beds. The interface between these grassy mud and sandy regions consists of areas with silty-sand bottoms.

Seven cores were taken from Winnapaug Pond by the Corps of Engineers to determine if the material would be suitable for beach nourishment or dike formation. The samples revealed material with a layer of sand over a layer of organic or glacial till material. The material is expected to be relatively free of contaminants except for fertilizers and herbicides carried in the runoff from the golf courses and homes surrounding the pond.

5. Aquatic Resources

a. Eelgrass Beds

Eelgrass Zostera marina beds are reported in Winnapaug Pond. They are located in the muddy areas located in the western and central area of the pond (DeLancey and Ganz, 1981). However, the size and density of these beds is declining due to the restricted flushing in the pond (Ganz, pers. comm., 1993).

b. Shellfish (Molluscan and Crustacean)

Due to the lack of hard substrate including rocks, lobsters Homarus americanus are not prevalent in the project area. There is a rock reef (piles) approximately 200 yards to one-half mile offshore that supports some finfish habitat and could provide some habitat for lobsters.

Surf clams are located offshore of Misquamicut Beach. No commercial shellfish species are known to occur on Misquamicut Beach. Random rakings on the beach did not reveal any shellfish.

Several species of commercial shellfish exist in Winnapaug Pond. They are at reduced levels though, from overharvesting, negligible recruitment to fisheries, and changes in substrata that resulted in limited suitable habitats (Waggett, 1992). The quahog Mercenaria mercenaria is the most abundant shellfish species surveyed in the pond (Waggett, 1992). Although the quahog is the most abundant shellfish in the pond, the density of this shellfish is low; 0.54 per square meter in 1989. This shellfish is found in the middle and western end of the pond. Softshell clam Mya arenaria was the second most abundant shellfish surveyed in 1981. The mean density of this clam was very low; 0.04 clams per square meter. Other shellfish reported to inhabit the pond in very low densities is the oyster Crassostrea virginica and the bay scallop Argopecten irradians. A shellfish management area is located on the north shore of the pond. This area has been seeded with quahogs and oysters but is not very productive.

c. Finfish

Typical sport fish found offshore near the rock reef (rock piles) are scup

Stenotomus chrysops, tautog Tautoga onitis, black sea bass Centropristis striata, striped bass Morone saxatilis, and bluefish Pomatomus saltatrix. In season, winter flounder Pseudopleuronectes americanus and fluke Paralichthys oblongus can also be found (Ganz, pers. comm., 9/29/93).

Winnapaug Pond supports a variety of finfish through various stages of life. The pond serves as a nursery for several larval and juvenile fish. Approximately 40 different species have been collected from Winnapaug Pond. Some of these species include winter flounder, tautog, herring Alosa spp., white perch Morone americana, bluefish, cunner Tautoglabrus adspersus.

6. Terrestrial Resources

Misquamicut Beach is a barrier beach affronting a large estuarine pond. Dunes created by wind blown sand on the beach are largest at the east end of the beach, presumably because that is the direction of littoral drift. The vegetation along the dune consists of American beach grass Ammophila breviligulata, beach rose Rosa rugosa, beach pea Lathyrus sp., and other species.

Typical saltmarsh vegetation (Spartina spp., Phragmites sp.) inhabits the edge of Winnapaug Pond. A deer was observed in this area. It has also been identified as a fall and spring migratory waterfowl and shorebird habitat, and is the northern limit for gadwall Anas strepera (U.S. Fish and Wildlife Service letter dated Sept. 10, 1993). Little Maschaug Pond also has a thin edge of wetlands species. This pond is mostly freshwater though. Both ponds are surrounded by golf courses, residential and business establishments.

7. Endangered, Threatened, and Rare Species

The Federally listed threatened Atlantic coast piping plover is known to nest on the outer beach of Maschaug Pond and Little Maschaug Pond. Except for the occasional transient endangered bald eagles or peregrine falcons, no other Federally listed or proposed threatened and endangered species under the jurisdiction of the U.S. Fish and Wildlife Service occurs in the project area (letter dated Sept. 10, 1993). Federally listed species under the jurisdiction of the National Marine Fisheries Service (NMFS) that may occur in the project area during the summer include the endangered leatherback, Kemp's ridley, green, and threatened loggerhead sea turtles.

The seaside sparrow is a State Species of Concern. This species nests in the saltmarsh along Winnapaug Pond. It arrives in late April to nest and leaves the end of September. Another species, the northern blazing star, used to occupy the edge of the dune, but no longer occurs in the project area (Enser, pers. comm., 10/5/93).

8. Historical and Archaeological Resources

The proposed project area consists of a barrier beach prone to coastal flooding and storm damages from Misquamicut Beach by way of Little Maschaug Pond on the west and from the Weekapaug Breachway on the east. Homes within the study area are being flooded from both the eastern and western limits of the proposed project area. The homes subject to this investigation are a part

protect the commercial structures located west of Misquamicut State Beach. The dikes would protect the Misquamicut residential area from flooding caused by increased water levels in Winnapaug Pond and Little Maschaug Pond. The 4000' beach of Alternative A would also provide increased recreational beach space in the study area.

The second alternative, Alternative B, consists of the construction of a 9200' beach stretching from Little Maschaug Pond in the west to the high dunes east of Misquamicut State Beach, and the construction of two dikes, one on each side of the Misquamicut residential area, as in Alternative A. The 9200' beach would protect the commercial structures located on both the east and west sides of Misquamicut State Beach, and would also increase the size of the state beach. The 9200' beach would also prevent some flooding in the entire study area, by reducing the overwash over the dunes. The dikes would provide additional protection to the Misquamicut residential area from flooding from Winnapaug Pond and Little Maschaug Pond. This alternative would also provide increased recreational beach space in the study area.

The third alternative, Alternative C, is similar to Alternative B, in that it consists of the construction of a 9200' beach, but includes the construction of a tide gate at the entrance to Winnapaug Pond, in the Weekapaug Breachway, instead of the construction of dikes, to reduce the flooding in the study area caused by increased water levels in Winnapaug Pond.

The fourth alternative, Alternative D, consists of the construction of a 9200' beach, and consists of elevating the houses in the Misquamicut residential area to above the 100 year flood elevation.

For Alternatives A, B, and C, several increments of the level of protection that could be provided, were examined. Increments were examined for Alternatives A, B, and C that would provide protection against a 10 year event, against a 25 year event, against a 50 year event, and against a 100 year event. For Alternative D, only a 100 year level of protection was examined, since house raisings traditionally consist of raising the house to 1' above the 100 year flood elevation.

Benefit Categories Examined

In analyzing the National Economic Development benefits which would be achieved by providing protection to the study area, the economic analysis was separated into three sections, the backshore analysis, the shorefront analysis, and the recreation analysis. In the backshore analysis, flood damage reduction benefits were estimated for the backshore part of the study area. The backshore area, which is the part of the study area located behind the structures along Atlantic Avenue, is subject to damage from high stillwater flooding elevations. In the shorefront analysis, storm damage reduction benefits were estimated for the structures located on both sides of Atlantic Avenue. The shorefront area is different from the backshore area in that it experiences damages from direct ocean attack, damages which include many flooding-type damages, but which also include damages caused by water coming over the dunes and the forces of the waves themselves, and thus the damages are not related only to the stillwater flooding elevations as they are in the backshore area. The structures located on the pond side of Atlantic Avenue in front of the pond could likely have a large portion of their damages attributable to the flooding of Winnapaug Pond. However, this was determined

Winnapaug Pond. This pond was suggested as sand source since much of the sand deposited into the pond is from littoral drift material entering in through the breachway. Locals have also stated that sand is also deposited in the pond by hurricane and storm overwash. The result is that the pond has become stagnant from the lack of flushing (Ganz, pers. comm. 1993). Locals feel that the removal of this sand would increase the biological productivity of the pond. However, test results to date have not determined whether or not Winnapaug Pond is a suitable sand source for beachfill.

The use of an offshore bar as nourishment material was also considered. Only sources of sand that would not diminish the protection sand bars afford coastlines would be considered.

Sand from an upland source is also being investigated.

a. Physical and Chemical Impacts

The physical and chemical impacts are dependent on the alternative(s) selected. Physical impacts associated with the beach alternative would include temporary impacts from placement of sand on the beach. This activity would cause some localized increase in suspended solids in the adjacent water body. Turbidity would cease shortly after construction was complete. The construction of groins, if any, could potentially effect the areas downstream by reducing the amount of material transported by littoral drift. Based on discussions with RIDEM, groins are no longer being considered.

An artificial reef placed offshore would deflect waves coming in shore. The result is an increase in the amount of sand deposited onshore. This would widen the beach and decrease storm wave damage.

Some turbidity would result from removal of sand from aquatic sources. Potential sources of sand include Winnapaug Pond and offshore sandbars in Block Island Sound. The area of turbidity should be small if a hydraulic dredge is used. Turbidity would cease quickly once construction stopped due to the coarse grained nature of the sediment. All sand sources would contain low levels, if any, of contaminants.

Placement of a dike or flood wall along the east side of Little Maschaug Pond and the west side of Winnapaug Pond would have no or minimal impact on circulation in either ponds, except for one dike alternative. This dike alternative would transect Little Maschaug Pond, essentially dividing the pond in half, is no longer being considered.

b. Biological Impacts

The backshore of Misquamicut Beach contains a narrow strip of dune in-between and in front of businesses and homes. The vegetation along the dune consists of American beach grass Ammophila breviligulata, beach rose, Rosa rugosa, beach pea Lathyrus sp., and other species. No commercial shellfish species inhabit the intertidal area of the beach. The benthic fauna on this beach is not expected to be high due to the coarse grained material and high exposure to ocean waves. Impacts to biological resources on Misquamicut Beach should be minimal.

Offshore impacts from turbidity would be small. No commercial shellfish species occur in the subtidal area immediately adjacent to the beach. In addition, finfish species and other mobile fauna, such as crabs or lobsters, would be expected to move from the area of disturbance. Potential impacts could occur if the offshore source of sand is also surf clam habitat.

Impacts to the biological resources in Winnapaug Pond could develop if it is used as a source of sand. However there is also a potential benefit to resources in the pond because the flushing rate could increase. Locals feel that this would improve the habitat for many species living in the pond. A tidal gate across the breachway would constrict tidal flows in and out of the pond, unless the entire breachway was resized.

More permanent impacts would occur in the two ponds if the dike or floodwall alignments are located within the aquatic environment. There would be permanent loss of subtidal, bottom and/or intertidal habitat. This could reduce the water quality in the pond and decrease some biological productivity. Moving the alignments upland would have permanent upland habitat loss. However, much of the upland has been disturbed by business or homes. Some alignments could permanently displace homes or businesses.

c. Endangered, Threatened and Rare Species Impacts

Potential impacts to Federally listed and State listed species could occur from the proposed project. Piping plover nests on the barrier beach to the west of Misquamicut Beach. Dike or flood wall alignments for Little Maschaug Pond would need to avoid this impact. In addition, the seaside sparrow, a State species of concern nests in the high marsh area on the south side of Winnapaug Pond. A dike or flood wall alignment on the west side of Winnapaug Pond is not expected to impact this species but would have to be looked at more closely, if necessary, in the Feasibility stage.

Activities offshore, such as sand mining or artificial reef construction, could have an impact on several Federally listed sea turtles. However this impact could be avoided by limiting construction activity to periods when the turtles are not in the area.

d. Historic and Archaeological Impacts

The placement of beachfill along Misquamicut Beach, as well as the structural alternatives of a wall, dike, or tide gate at the eastern and western limits of the study area should not impact cultural resources. These areas have previously been disturbed by construction, erosional or other related activity. Areas chosen as suitable for beachfill would have to be investigated for their possible cultural resource potential. The raising of homes within the Misquamicut Historic District could potentially impact significant historical resources. If this project proceeds to a further stage in the planning process, then a detailed plan would be selected. At that time, this plan would be investigated for its potential effect upon historic or archaeological resources. The Rhode Island State Historic Preservation Office is expected to concur with these determinations.

3. Coordination

This project was coordinated with local, State, and Federal agencies. A site visit was held on September 1, 1993 in which the public and agency staff were invited to learn about the proposed project and provide input to the various alternatives. Due to the large number of people at this meeting a second meeting with State agencies was held on September 24, 1993. Information was exchanged between the different agencies and researchers. To facilitate recommendations on the different alternatives a third meeting was held on September 29, 1993 to "walk through" the proposed dike and flood wall alignments. Information gained from these meetings were used to eliminate alternatives which would not meet the necessary permit and environmental requirements.

The following agencies were coordinated with either through a letter or through meetings.

Federal

U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
National Marine Fisheries Service

State

Rhode Island Natural Heritage Program
Rhode Island Historical Office
Rhode Island Department of Environmental Management,
Division of Water Resources
Office of Environmental Coordination
Division of Coastal Resources
Division of Fish and Wildlife
Rhode Island Department of Administration
Coastal Resources Management Council

Local

Westerly Planning Zone Office
Westerly Town Manager
Branford Fire Department
Dunns Corners Fire Department
Misquamicut Fire Department
Watch Hill Fire Department
Westerly Fire Department
Weekapaug Fire Department

Other

Misquamicut Businessman's Association
Salt Pond Watcher of Rhode Island
Save Our Shores
Weekapaug Beach Association
Westerly Residents for Thoughtful Development
University of Rhode Island

4. Recommendations

Based on discussions with particular agencies and pertinent regulations, the following recommendations are made for the proposed project:

Both Little Maschaug Pond and Winnapaug Pond waters are classified as an Outstanding Natural Resource. It is also identified as important habitat for wildlife and other natural resources. No degradation of these waters is allowed. Because of this distinction, fill in any amount in either pond, will not be permissible (WAITING FOR LETTER FROM DEM TO CONFIRM). Therefore all dike and flood wall alternatives need to be located outside the aquatic environment. In addition, the 404 (b) (1) guidelines under the Clean Water Act would require that all non-aquatic alternatives with minimal upland impact, such as house raising, be evaluated first.

Coastal Resources Management Council regulations support nonstructural methods over structural methods for work in the coastal zone. Beach nourishment is preferable for storm wave reduction on Misquamicut Beach. The State and local officials would desire the use of Winnapaug Pond as a source of beach material. However, timing would be critical to natural resources in the pond. Generally the late spring and the summer would not be suitable for construction. Winter flounder is also reported to spawn in Winnapaug Pond. If this is a significant population and construction impacts would occur, then construction may need to occur after September and before February 1 to avoid all of the above impacts.

Impacts to avoid threatened, endangered and rare species can be accomplished by limiting the construction window, or placing construction activity away from these species when they are in the project area. The time period for piping plovers and seaside sparrows are April to September, and the sea turtles to the summer months.

Impacts to cultural resources would need to be investigated further in the Feasibility study. In particular, house raising could impact the historical quality of the Misquamicut Historical District. There is a potential conflict between the Clean Water Act which requires investigating other practicable alternatives first before allowing fill into waters and wetlands of the United States, pertinent Rhode Island regulations, and the National Historic Preservation Act which is intended to reduce or prevent impacts to cultural resources. Other sand sources will have to be investigated for historical or archaeological potential.

Regulatory Division sent a letter to the Town of Westerly, Director of Public Works on May 19, 1993. Regulatory Division expressed concern that fill may have been placed below the extreme high tide line at Misquamicut Beach to alleviate beach erosion problems without a Corps permit. Discussions with Denise Leonard (Regulatory Division, Oct. 27, 1993) indicated that results of their inquiry was inconclusive and that no further action would be taken.

REFERENCES

DeLancey, Lisa and Arthur Ganz. 1981. A Shellfish Survey and Management Program, Brightman (Winnapaug) Pond, Westerly, R.I. R.I. Department of Environmental Management, Division of Fish and Wildlife, Young Adult Conservation Corps, Leaflet 56.

Enser, Rick. October 5, 1993. Rhode Island Natural Heritage Program, personal communication.

Ganz, Arthur. June 1993. Rhode Island Department of Environmental Management, Division of Fish, Wildlife, and Estuarine Resources, personal communication.

Ganz, Arthur. September 1993. Rhode Island Department of Environmental Management, Division of Fish, Wildlife, and Estuarine Resources, personal communication.

Gorman, Ellen. Date Unknown. Winnapaug Pond: Restoration Challenge. Leaflet presented as a community service by The Sounds Conservancy, The Salt Pond Coalition, and The Westerly Sun/Sun Graphics.

Sisson, Richard and Richard Satchwill. March 1990. Rhode Island Department of Environmental Management, Division of Fish and Wildlife, Federal Aid to Fisheries Project, F-51-R Rhode Island, Segment Report 1.

Waggett, Caryl. August 1992. Recreational and Commercial Fisheries Resources of Winnapaug (Brightman) Pond. Coastal Fisheries Laboratory, Rhode Island Department of Environmental Management, Division of Fish and Wildlife.

APPENDIX

Coordination Letters



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930

OCT 12 1993

Mr. Joseph L. Ignazio
Director of Planning
New England Division
Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Ignazio:

In response to discussions with Ms. Demos of your staff, Ms. Colleen Coogan, of my staff, has reviewed the Beach Erosion Control Study for Misquimicut Beach in Westerly, Rhode Island. We have determined that, dependant on final plans, the project is not likely to adversely affect endangered or threatened species that may be present in the project area. Further consultation pursuant to Section 7 of the Endangered Species Act may be necessary, however, if the results of further study identifies sand from offshore borrow areas as the preferred source for beach fill material. Use of hopper dredges during warm water periods (June through November) may lethally take sea turtles that seasonally occur in Block Island Sound, offshore of Misquimicut Beach.

Notification of the potential occurrence of the endangered leatherback sea turtle (Dermochelys coriacea) in the project area was forwarded to you by our Milford, Connecticut staff in a letter dated September 10, 1993. Additional listed species that may transit through the Block Island Sound during summer months include endangered Kemp's ridley (Lepidochelys kempi), green (Chelonia mydas), and threatened loggerhead (Caretta caretta) sea turtles. These turtles are benthic feeders and are especially susceptible to the hopper dredge's quick moving dredge head. Leatherbacks, which forage primarily on jellyfish throughout the water column, are not often adversely affected by hopper dredges.

Alternatives evaluated in the study, according to your August 13, 1993 letter, include acquisition of sand from a saltwater pond behind the beach as well as construction of a revetment, groin, dike, and/or breakwater. These activities are not likely to adversely affect leatherbacks or any other listed species of sea turtles.

Ms. Demos has indicated that preliminary study results show the saltwater pond may not be a suitable source for beach fill material, therefore, offshore borrow areas may be considered as alternate sources. As discussed above and in the attached report from the Waterways Experiment Station, hopper dredges deployed in



areas where sea turtles occur can lethally take turtles by entrainment in the draghead. If a hopper dredge is to be used in Block Island Sound between June and November, a formal Section 7 consultation would be required. Use of a clamshell dredge during that period, or dredging from December through May would preclude adverse affects to listed species and eliminate the need for a formal consultation pursuant to Section 7 of the Endangered Species Act.

In addition to our responsibilities under the Endangered Species Act, NMFS is concerned about affects to all living marine resources. Our Habitat Conservation staff has expressed a need for additional information regarding the specific actions being considered, especially the possibility of dike construction. The potential for affecting wetlands and submerged aquatic vegetation in areas such as Little Maschaug Pond are of particular concern. As a result of these concerns, we would appreciate continued updates on the recommendations resulting from the on-going Beach Erosion Control study at Misquimicut Beach.

In summary, if final project plans do not include dredging of borrow areas in the Block Island Sound by hopper dredge in warm water months (June through November), the Misquimicut Beach Erosion project is not likely to adversely affect listed species and no further consultation is needed pursuant to Section 7 of the Endangered Species Act. However, review of the results of the Misquimicut study may result in additional recommendations from NMFS staff regarding other living marine resources. Please call Colleen Coogan (508 281-9291) if you have any questions regarding the ESA consultation process, or Michael Ludwig (203 783-4200) for discussion regarding impacts to living marine resources.

Sincerely



Richard B. Roe
Regional Director

Attachment

cc: Ludwig
Demos, COE



RHODE ISLAND MOBILE SPORTFISHERMEN, INC.

P.O. BOX 281 WESTERLY, RHODE ISLAND 02891

September 29, 1993



Colonel Brink P. Miller
Division Engineer, U.S. Army Corps of Engineers
424 Trapelo Rd.
Waltham, Ma. 02254-9149

bfm
Dear Sir:

I am writing as president of the Rhode Island Mobile Sportfishermen, a saltwater fishing club of approximately 500 members. We are very concerned about the present interest in rebuilding the beaches along Misquamicut Beach in Westerly, Rhode Island.

At a recent meeting attended by State and Town officials, the general public and the Corps of Engineers, there was discussion on several methods of rebuilding these beach areas. We wish to make known our concerns and the concerns of the general public.

The placement of groins was one method talked about. This method raises several questions. What becomes of our Rhode Island constitutional rights to lateral passage? When groins are placed, they disrupt the natural movement of sand that runs up and down the beach as well as in and out. These groins do trap sand on the upstream side, but they rob sand from the downstream areas. How far and how many groins would we have to pay for and still not get the desired results? Sea walls should not be used because they steepen the beach and cause more erosion at either end and then must be continually extended. Hard stabilization is not ecologically or economically sound.

Another method mentioned was that of dredging sand from the bottom of the adjacent salt pond and using that fill to replenish the beach. It was described as ending up as a much wider beach than is there now. In Rhode Island, filled lands would come under the public trust doctrine and be opened to the public. We do not think this would suit the present owners. Another concern is how safe is the fill that is on the bottom of the pond? Many forms of wild life are in trouble now from pollution.

The use of offshore barriers was also mentioned as a possible way to break up wave action to slow damage. I have not seen any studies that show this to be a good solution. I have seen reports that say these have limited temporary value. At times of large storms, these barriers have broken up and ended up as litter on the beaches.

I realize that people wish to protect their property but we do not feel that anything should be done that restricts the natural dynamics that occur on a barrier beach.

We would like to be kept informed of any public hearings and further plans for work in this area. Thank you for your consideration of this request.

Sincerely,

Arthur C. Noyes

President,
Rhode Island Mobile Sportfishermen

cc: Westerly Town Council, State Senator Dennis Algieri
Dave Borden, D.E.M.



Town of Westerly, R. I.

CONSERVATION COMMISSION

September 21, 1993

Mr. Joseph L. Ignazio
Director of Planning
Department of the Army
New England Division Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

Dear Mr. Ignazio:

This letter is in response to the request for comments regarding the proposed project for beach erosion control at Misquamicut Beach in Westerly, Rhode Island. The comments below were developed at the regular monthly meeting of the Westerly Conservation Commission, September 21st. Although the comments were requested by September 7th in your letter to various agencies (August 31, 1993), Ms. Cathy Demos verbally extended this date (ASAP) at the September 1st meeting at Misquamicut.

At this time we can not be very specific on each of the alternatives being evaluated due to their lack of detail. The following information, concerns, questions, etc. are offered so that the process will not overlook items we feel are important.

1. Limited reconstruction of the beach may be beneficial using dredged material from the adjacent pond as long as contaminants that may be in place are not released to the environment.
2. Any tidal gates installed at the breachway should not interfere with existing boating and recreational fishing and should not create adverse effects on the pond's fishery.
3. In general the RI CRMC prohibits the installation of hard structure for good reason. In your evaluation of the use of these types of structures, the effects of deflected energy to areas adjacent to the study area should be considered.
4. Some of the hard structure proposed would limit and even eliminate lateral access along the beach front that the public currently enjoys and is granted by law. To take away this privilege is to significantly reduce the quality of life of persons using this prime natural resource.



Town of Westerly, R. I.

CONSERVATION COMMISSION

Page 2

5. The dike mentioned at the western extremity again should not limit public access that currently exists.
6. The project engineer, Dave Larson, discussed plans to widen the beach. To what extent is unknown. We are aware that there is a natural rock reef parallel to shore a short distance offshore (100 yards \pm). This reef likely harbors marine life which in turn attracts gamefish helping to make this area a prime recreational fishing area.
7. The artificial reef concept seems risky and unproved for this location. The public travels to this area to enjoy the natural wave action for swimming, surfing, boogie boarding and surf boarding. These activities may be curtailed thereby adversely affecting the public's enjoyment and businesses relying on their patronage.

The undersigned and two other commission members attended the September 1st briefing. It was apparent the Corps' personnel were not familiar with the area and did not have all the information needed to factor in all the public's needs and concerns. It is disturbing to find your study in following federal guidelines does not account for recreational values. We feel this is very important to the town's quality of life as well as impacts to the local economy. The public using this beach area supports various businesses, e.g. fisher persons support tackle/bait businesses, motels, restaurants, stores, gasoline stations, etc. This should be factored into your cost/benefit ratio.

We are ready to assist the effort to properly protect this natural resource. Please utilize the considerable knowledge that exists with our Conservation Commission members. We look forward to working with you.

Very truly yours,

Joseph H. Dawson
Chairman,
Westerly Conservation Commission

c/o Westerly Town Hall
45 Broad Street
Westerly, R.I. 02891

xc: Town Council, Attn: R. Comolli, Chairman
Town Manager

Sept 18, 1993

To Col. Brink Miller and David Larson and John T. Smith
Army Corp of Engineers
424 Trapelo Rd
Waltham Mass 02254 9149

Dears Sirs,

I am writting as a concerned citizen about the Army Corps. on going study of Winnapay pond in Westerly Rhode Island.

I have an aquaculture permit and am currently leasing from the state of R.I one and a half acres of bottom in Winnapay pond. This is a commercial venture from which I will be deriving a substantial portion of my income. My assent # is B-93-5-91.

I am very much concerned with the plans of the army Corp.. I am also a volunteer "pond watcher" and have for 8 years been taking water samples in Winnapay pond. These samples are analysed by the state and used as a long term data base. I take these samples in the area of the pond directly behind the Misquamicut State Beach.

I also have lived on the pond for 18 years and have fished, clamed and crabbed in it for

18 years.

I am requesting that the Army Corp put me on any mailing lists it has in regards to this proposed project. I would also like to request to be placed on any advisory committees the Army Corp or C.R.M.C. may have regarding Winnapay Pond.

I am very fear full of any dredging in the pond except toward the EASTERN end. I feel any other dredging will be harmful to the existing (although currently limited) eel grass. It will also impact fish mortality and negatively impact the flat fish brood stock thus having a negative impact on the state commercial fisheries as well as recreational fishing.

I do not believe dredging the Western end of the pond will have any recreational benefits as there are no public access ways marked or used frequently by the public. (see Virginia Lee U.S.A.)

I must state that it is my believe that almost all of the beach sand lost from the "beach front" has not entered the pond but rather has traveled along it. (lateral motion). This could easily be proven by the use of survey markers in the pond measuring pond/sand depths over a period of time.

I would like to state for the record that Winnapung pond is NOT in bad shape. It has good water circulation, an active wildlife and only pockets of potential pollution (caused on the Northern side of the pond by extensive home building). There is no I repeat No economic justification for extensive dredging of Winnapung Pond. It will NOT increase public recreation. It also may be very harmful to the osprey, oyster catchers, otters, least bitterns, egrets, blue herons, night herons, blue crabs, shellfish and occasional eagle if done.

Thank you for your consideration.
Please put me on any lists etc concerning
this fragile coastal pond.

Sincerely yours,

Jeffrey T. Gardner

JEFFREY T. GARDNER
227 SHORE RD
WESTERLY RE 02891
phone 401 322 7280

- I am,
1. Winnapung Aquaculture lease holder
 2. " " "pond watcher"
 3. Vice President of Salt Pond Coalition
 4. Concerned citizen



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Habitat & Protected
Resources Division
Milford Laboratory
Milford, Connecticut 06460-6499

September 10, 1993

Mr. Joseph L. Ignazio
Director of Planning
New England Division
Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

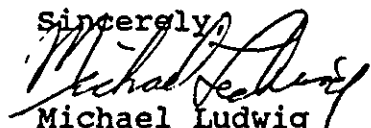
Dear Mr. Ignazio:

We have reviewed the information regarding the Beach Erosion Control Study for Misquimicut Beach at Westerly, Rhode Island. The use of Winnapaug Pond as a source of beach material, the nature of the activities proposed for the ocean face erosion control and the probable presence of leatherback sea turtles (Dermochelys coriacea) protected under the Endangered Species Act (ESA) are all issues of concern to the National Marine Fisheries Service. Additionally, the use of a dike in the mix of potential options for beach erosion control requires explanation.

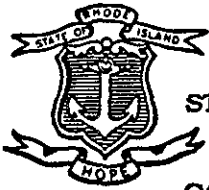
The endangered leatherback sea turtle occupies coastal waters of Rhode Island during the summer months, foraging for jellyfish. Its presence in the project area engenders assessment under Section 7 of ESA.

Should you wish to discuss this matter please contact Colleen Coogan at (508) 281-9291 or me at (203) 783-4200.

Sincerely,


Michael Ludwig
Fishery Biologist





STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

COASTAL RESOURCES MANAGEMENT COUNCIL

Oliver H. Stedman Government Center
4808 Tower Hill Road
Wakefield, R.I. 02879-1900
(401) 277-2476

Department of the Army
New England Division, Corps of Engineers
Mr. Joseph Ignazio, Director of Planning
Impact Analysis Division
424 Trapelo Road
Waltham, MA 02254-9149

September 10, 1993

Dear Mr. Ignazio:

The Coastal Resources Management Council (CRMC) appreciated the invitation to the Army Corps preliminary assessment meeting for Misquamicutt Beach, on September the 1, 1993. At this time, it would appear that a number of projects are under consideration by the Corps. We realize that both flooding and storm damage concerns need to be addressed, but as managers of the State's coastal resources, we have concerns regarding how this is approached.

First, let me say that coordination with the Town of Westerly is imperative for the rectification of the flooding problems. Currently, the town drainage system collects the water that pools in the low-lying neighborhood at the western end of the study area, and channels it towards Winnapaug Pond. Clogging and insufficient operation of this system, coupled by the storm overwash and heavy rains, caused the Town to conduct unpermitted work to alleviate the flooding situation. As a result, the Town is currently under a consent agreement with the CRMC, to provide a new drainage design for an ocean outfall, that will ultimately replace the outdated, and overloaded pond discharge system. This outfall system may involve pumping stations, and redirection of flow to the western end of Atlantic Avenue. Any efforts by the Corps to improve flooding and drainage would not work in isolation from the existing plans of the Town of Westerly. In addition, the proposed dike system at the western end of the study area should also be designed and considered in conjunction with the Town's drainage project, to ensure that the project accomplishes the goal of rectifying flooding and drainage inadequacies. The dike would most likely need to tie in to the dune or shore at or near where an ocean outfall pipe might be.

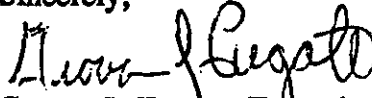
For your information, the golf course that lies just north of Little Mashaug Pond, is also attempting to correct flooding problems of its own, and is expected to propose some sort of project shortly. Should a dike be considered an appropriate solution to halt the storm washover that enters into this neighborhood through Little Mashaug Pond, the CRMC will review the construction details at the appropriate time.

Massive beachfill is our preferred option for the length of Misquamicutt Beach, so that the barrier beach can retain its natural appearance and function. In fact, under our current policies, structural shoreline protection is prohibited. Therefore, unless strong justification can be provided for the selection of revetments, seawalls, riprap, or any other hardened structure along the length of the beachface, it is strongly discouraged at this time. The merit of placing a series of groins or jetties is also strongly questioned, due to the decreased recreational effects, and the potential to damage other beach areas along the South Shore, such as Green Hill and Matunick Beach, which can ill afford sand loss. We are of the opinion that beachfill is needed to widen the beachface, and to raise the height of the overall beach profile. However, we will require that where such a project benefits private property, a public access easement or right-of-way agreement is stipulated as a condition of the project. This will be a high priority for CRMC and the State as we review the public benefits and merits of this project.

The CRMC is not in opposition to the use of Winnapaug Pond as a sediment source. In addition to the sediment sampling of the pond, I suggest you review the material Art Ganz, Senior Shellfish Biologist, has provided. If a habitat restoration project for the pond can be coordinated with Corps removal of sediment, the CRMC would encourage and assist these efforts. The local Salt Ponds Coalition, The Sounds Conservancy, and RI Department of Environmental Management's Division of Fish, Wildlife, and Estuarine Resources, may all assist towards this end.

I appreciate the opportunity to comment on some of the potential methods to facilitate this project. Let me assure you that the CRMC will assist you in any way possible, as this study, and hopefully this project, proceeds. If you have any questions regarding our comments, please call me, or Donna Doyle, at 401-277-2476.

Sincerely,



Grover J. Fugate, Executive Director
Coastal Resources Management Council



United States Department of the Interior

FISH AND WILDLIFE SERVICE

New England Field Offices
400 Ralph Pill Marketplace
22 Bridge Street, Unit #1
Concord, New Hampshire 03301-4901

Joseph L. Ignazio
Planning Directorate
Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

September 10, 1993

ATTN: Impact Analysis Division

Dear Mr. Ignazio:

This responds to your letter dated August 13, 1993 requesting information on the presence of Federally listed and proposed endangered or threatened species in relation to the proposed reconnaissance Section 103, Beach Erosion Control study for Misquimicut Beach in Westerly, Rhode Island. The following comments are also provided in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The most significant natural resource in this area is Winnapaug Pond. This area provides important habitat for many species of coastal fish and wildlife. It has been identified as winter flounder spawning and wintering habitat, fall and spring migratory waterfowl and shorebird habitat, and is the northern limit for Gadwall (*Anas strepera*).

Based on information currently available to us, the Federally listed threatened Atlantic coast piping plover (*Charadrius melodus*) is known to nest on the outer beach of Maschaug Pond and Little Maschaug Pond, at the western end of the study area. No other Federally listed or proposed threatened and endangered species under the jurisdiction of the U.S. Fish and Wildlife Service are known to occur in the project area, with the exception of occasional transient endangered bald eagles (*Haliaeetus leucocephalus*) or peregrine falcons (*Falco peregrinus anatum*). However, a candidate Category 2¹ and State listed endangered plant, the Northern blazing star, is found in the proposed project area. The seaside sparrow (*Ammodramus maritima*), a State Species of Concern, is known to breed in this area. We suggest that you contact Chris Raithel, Division of Fish and Wildlife, Box 218, W. Kingston, RI 02892, 401-789-0281 for information on the piping plover and Rick Enser of the Rhode Island Natural Heritage Program at 83 Park St., Providence, RI 02903, telephone 401/277-2776, for information on state listed species that may be present.

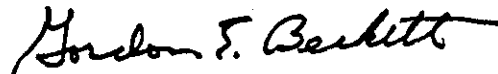
¹ Information is available which indicates that proposing to list as endangered or threatened is possibly appropriate but for which conclusive data are not currently available to support proposed rules.

It is unclear from the information provided in the letter what specific alternatives will be recommended. Without more detailed information, it is not possible to determine the impacts to fish and wildlife resources from this project. The study should evaluate a full spectrum of alternatives for the project and provide an extensive discussion of the various alternatives and their environmental impacts. In most cases, the Service favors nonstructural versus structural alternatives. Dredging in the Winnapaug Pond should be avoided, unless it can be shown to improve or restore habitat. The Service will make more detailed comments upon receiving a copy of the reconnaissance Section 103, Beach Erosion Control Study.

Changes to the beach fronting Maschaug Pond or Little Maschaug Pond resulting from any of the proposed alternatives may adversely affect nesting piping plover habitat. Alternatives including the construction of groins and dikes should carefully consider how these structures impact nearby beaches.

A list of Federally designated endangered and threatened species in Rhode Island is included for your information. Thank you for your cooperation and please contact Susi von Oettingen of this office on endangered species issues at (603) 225-1411; on issues concerning the Fish and Wildlife Coordination Act, please contact Gregory Mannesto of our Rhode Island Field Office at 401-364-9124.

Sincerely yours,



Gordon E. Beckett
Supervisor
New England Field Offices

Inclosure

APPENDIX C

ECONOMIC ANALYSIS

Misquamicut Beach
Westerly, Rhode Island
Section 103 Reconnaissance Study
Economics Appendix

Introduction

The purpose of this appendix is to estimate the National Economic Development benefits of providing flood and storm damage protection to the Misquamicut Beach area in the town of Westerly, Rhode Island. The town of Westerly is located in the southwestern-most corner of Rhode Island, on the border of Connecticut. This appendix includes a description of the study area, a description of past and potential flood and storm damages in the study area, estimates of the recurring and expected annual flood and storm damages, and the calculation of annual benefits of the alternative protection plans examined. The analysis contained in this appendix was performed at the reconnaissance level of detail.

Methodology

The purpose of this appendix is to calculate the economic benefits of providing flood and storm damage protection to the study area, in order to evaluate whether proposed improvement plans are economically feasible. A proposed project is considered economically feasible if it has a benefit to cost ratio equal to or greater than 1, that is, if the benefits of the project equal or outweigh the costs of the project. In a general sense, the economic benefits of a project are determined by comparing the with project condition to the without project condition, and evaluating the difference between the two conditions. The benefits calculated in this appendix are estimated based on current Corps of Engineers guidelines. In accordance with Corps guidelines, the primary benefits examined are those which are defined in Corps guidance as National Economic Development (NED) benefits. NED benefits are defined as increases in the net value of the national output of goods and services. According to current guidance, only NED benefits can be counted against a proposed project's costs to evaluate the project's economic feasibility. In accordance with Corps guidelines, benefits are expressed in average annual equivalent terms, based on the fiscal year 1993 federal interest rate for water resources of 8 1/4 percent and a 50 year period of analysis. All benefits are stated in 1993 prices.

Description of Study Area

The study area consists of an approximately three mile stretch of shoreline located on Block Island Sound in Westerly, Rhode Island, extending from Little Maschaug Pond in the west to the Weekapaug Breachway in the east. A town road called Atlantic Avenue runs along the shoreline for the entire length of the study area. The study area includes a densely developed residential area of Westerly known as Misquamicut, which is located at the western end of the study area, behind Atlantic Avenue. The study area also includes Winnapaug Pond, a large pond located behind Atlantic Avenue, which stretches from the edge of the Misquamicut residential area in the west to the Weekapaug Breachway in the east, which is the eastern end of the study area. The Weekapaug Breachway provides access to the pond. The study area also includes Misquamicut State Beach, a large, high quality beach which is a major recreational and tourist attraction in the summer, and the Westerly town beach.

The town of Westerly is bordered to the north by the town of Hopkinton, Rhode Island, to the east by the town of Charlestown, Rhode Island, to the south by Block Island Sound, and to the west by the Pawcatuck River, which forms the border between Rhode Island and Connecticut. The Misquamicut area of Westerly is dominated by the summer recreation and tourism attractions it contains, including the beaches, boating opportunities in Block Island Sound, and the large number of seasonal hotels, restaurants, night clubs, amusements, and shops which are located along Atlantic Avenue. The residential section of Misquamicut contains primarily single family homes located in a relatively densely developed grid of streets. The area contains both seasonal and year-round homes.

Economic Setting

According to the 1990 US Census, in 1990 Westerly had a total population of 21,605, and contained 10,521 housing units, of which 2,051 were seasonal units. Employment in the town fluctuates significantly depending on the time of year, reflecting the increased employment in the summer months with the summer tourism and recreation related industries. In August, 1993, the most recent month for which data was available, the total employment in the town of Westerly was 11,206, and the town had an unemployment rate of 4.5 percent. In March, 1993, which would reflect winter-level employment, total employment in the town was 6,425. Of the total employment of 6,425, the largest employment sectors were the service sector, the retail trade sector, and the manufacturing sector. The employment by sector for March, 1993 in Westerly is shown below.

<u>Employment Sector</u>	<u># employed</u>
Agriculture	27
Manufacturing	1,037
Construction	218
Transportation & Utilities	225
Wholesale Trade	153
Retail Trade	2,159
Finance, Insurance & Real Estate	419
Services	<u>2,187</u>
TOTAL	6,425

Flood and Storm Damage History

The commercial properties located in the study area along Atlantic Avenue have experienced significant damages in the past two years from several severe storms. In December, 1992, a severe storm caused damages of at least \$315,000 to the businesses located along Atlantic Avenue. These damages included the following types of damages: structural damage to buildings; loss of or damage to outside stairs, decks, walkways, and parking lots; loss of or damage to inside furniture, rugs, and other contents; damage to foundations; damage to seawalls; and lost inventory. In addition to the damages, significant beach erosion occurred; Had sand not been able to be bulldozed back up towards the structures and replenished on the beach, the erosion would have left many of the businesses dangerously exposed to the ocean, and would have critically reduced the capacity of Misquamicut state beach, both of which would have had severely negative effects on the economic health of the area. The storms also

caused increased clean-up, repair, and sand moving costs to be incurred by the state and the town. Based on the hydrologic analysis of the study area, the December 1992 event was approximately a 5 year event, which has a 20% chance of occurrence in any given year.

Another storm occurred in March, 1993, which caused damages of at least \$200,000 to the businesses in the study area and caused additional erosion in some areas. Hurricane Bob, of August, 1991, also caused damages of at least \$200,000 to the businesses in the study area. In all, over the past two winter seasons, the businesses in the study area have suffered damages of at least \$715,000. These figures were obtained by personal or telephone interviews with the business owners or managers, for those businesses which were able to be reached.

In the more distant past, the storms of record for the study area are the Hurricane of 1938 and Hurricane Carol of 1954. In the Hurricane of 1938, hundreds of houses were destroyed in the area and 60 lives were lost (House Document No. 85, June 1955, p. 12). The Hurricane of 1954 caused damages of nearly 3 million dollars in the study area (Corps of Engineers report, 1962). In both cases, many shorefront structures were completely destroyed, with only foundations remaining, and many others were completely moved off of their foundations. Fortunately, in the 1954 Hurricane, no lives were lost in the area due to prompt evacuation.

In addition to the storm damages that have occurred in the recent past along the shorefront of the study area, areas in the backshore of the study area, which are primarily residential areas, are subject to flooding damages, or have the potential to experience flooding damages, particularly in events with a lower probability of occurrence than the five year event. The flooding in the backshore areas of the study area would be caused by a combination of overwash over the shorefront dunes and high water levels on Winnapaug Pond and Little Maschaug Pond.

Without Project Condition

The economic benefits to a proposed project are estimated by examining the without project condition and the with project condition, and evaluating the difference between the two conditions. In this case, the without project condition was determined to be equal to the no action condition, since it was judged to be unlikely that the local or state interests would construct any sort of permanent, effective protective measure or measures which would reduce the vulnerability of the study area to severe flood and storm related damages. As a result, in the without project condition, it is projected that the study area will continue in the future to be susceptible to problems similar to those that have been experienced in the recent past, and will have the potential to experience even greater flood and storm related losses if more severe events with a lower probability of occurrence occur.

With Project Condition

For the with project condition, several different alternative improvement plans were examined. The first alternative, Alternative A, consists of the construction of a 4000' beach stretching from Little Maschaug Pond to the western end of Misquamicut State Beach, and the construction of two dikes, one on each side of the Misquamicut residential area. The 4000' beach would

of the Misquamicut Historic District, a summer resort area comprised largely of small, unpretentious summer cottages mostly of early to mid-20th century construction. This historic district is a densely populated area located between Shore Road (Route 1A) and Block Island Sound and at the west end of Winnapaug Pond (Rhode Island Historic Preservation Commission 1978:29). Beachfill for placement along Misquamicut Beach may be obtained from Winnapaug Pond, a saltwater pond located behind the beach, or from other offshore or upland sites yet to be investigated.

II. ENVIRONMENTAL CONSIDERATION

1. No Action Alternative

Misquamicut Beach and the area around it will continue to experience flood and storm damage if no action is taken to reduce the threat from storm waves and floods. The beach will erode and residential and business establishments will become vulnerable to flood and storm damage. The beach as a recreational area will be reduced as the loss of sandy substrate continues.

No environmental impacts, beyond naturally occurring events, would occur for this alternative.

2. Beach Erosion and Flood Control Alternatives

The Misquamicut Beach area suffers flood and storm damage. Commercial areas located to the east and west of Misquamicut State Beach suffer storm damages, while the low lying residential area located behind Misquamicut Beach and between Little Maschuag Pond and Winnapaug Pond are subjected to flooding from the two ponds. The proposed project would reduce or eliminate storm and flood damages to the business and residential community of Misquamicut Beach.

The following alternatives considered for Misquamicut Beach include structural and nonstructural plans in combination and in separate scenarios. Alternatives considered for storm protection along the beach included beachfill alone, in combination with a revetment, or groins. A breakwater and an artificial reef placed offshore were also considered.

Of all these alternatives, beachfill was considered to be the most acceptable because the Rhode Island Coastal Resources Management Council's policies promote nonstructural over structural solutions in the coastal zone.

Alternatives to protect homes in the low lying area behind Misquamicut Beach and between the two ponds include a dike or flood wall along the east edge of Little Maschaug Pond and the west end of Winnapaug Pond. A tidal gate at the Weekapaug Breachway and raising homes were also considered. These alternatives would work in combination with the storm damage reduction alternative selected for the beach.

The flood control alternatives have not been determined yet. This alternative will be dependent on comments received by the Rhode Island Department of Environmental Management (RIDEM) and the economic justification.

A potential source of nourishment material for Misquamicut Beach is

to be too complex to analyze separately in this reconnaissance-level investigation. In the recreation analysis, recreation benefits were estimated since the improvement plans examined consist of the creation of additional beach space, space which have significant recreational value.

Backshore Analysis

For the backshore analysis, flood damage reduction benefits were estimated in accordance with traditional Corps of Engineers flood damage analysis methodology. The first step in estimating the flood damage reduction benefits was to inventory the structures in the 100 year flood plain in the study area. The largest concentration of structures in the 100 year flood plain of the study area is the Misquamicut residential area. The Misquamicut residential area is located at the west end of the study area, west of Winnapaug Pond and behind Atlantic Avenue. The first floor elevation of each house in the Misquamicut area was estimated using 2' contour maps that were provided by the town of Westerly for the area. In this area, 318 houses were identified as having first floor elevations at or below elevation 14. Elevation 14 was used as the cutoff elevation, as houses with first floor above elevation 14 were determined to have insignificant flood potential since the 100 year flood elevation in the study area was determined in the hydrologic analysis to be elevation 12. Eight hotels located in the Misquamicut backshore area were also included in this part of the analysis. Also, a number of residential structures located on both sides Atlantic Avenue to the west of the commercial development were also included in the backshore analysis in order to simplify the analysis.

A second area of particularly low-lying homes was identified at the eastern end of the study area. Houses located on Breach Drive, as well as houses located in low-lying areas behind Winnapaug pond, including parts of Ricci Road, Harbor Drive, and Cove Street, were identified as having flood damage potential. A total of 63 homes were included for this second damage area. Since detailed topographic mapping was not available for this second area, the first floor elevations used are rough estimates. The estimates were made based on elevation contours from USGS quad sheets, by comparing the first floor elevations of the structures to the elevation of surrounding raised houses, and by comparing the elevations of the structures to any surrounding new houses, since new houses would have to be built above the 100 year flood elevation. If this project proceeds to the more detailed feasibility study phase, the first floor elevations of these structures would be surveyed for greater accuracy, and the first floor elevation of additional surrounding houses in the 100 year flood plain could also be surveyed to be sure that all houses with first floor elevations below the 100 year flood plain are included.

There are additional houses located in the 100 year flood plain in the areas behind Winnapaug Pond and immediately east of the Weekapaug Breachway that were not included in the analysis. However, these houses appeared to be relatively higher and thus less prone to damages. Due to the large geographic area covered by the entire 100 year flood plain in the study area, and since it was not possible to survey such a large area in this reconnaissance study phase, these houses were not included. Instead the two largest and lowest lying areas were included. Since the lower lying areas contribute by far the most to the total annual damages, and since structures located relatively high would contribute only a very small amount toward annual damages, it was determined that any possible error due to this methodology would be unlikely to

significantly affect the overall economic evaluation and benefit calculations.

Based on the damage survey methodology described above, the following table shows the distribution of estimated first floor elevations for the residential structures included in the analysis.

<u>First Floor Elevation</u>	<u># of houses</u>
<7	6
7	11
8	28
9	62
10	68
11	62
12	47
13	55
14	<u>42</u>
Total	381

All of the houses in the two damage areas were categorized based on the size and type of house. Typical damage functions were then used for each structure category to represent the typical flood damages that would be likely to occur at various levels of flooding. The typical damage values for each house at each flooding elevation were then combined with the estimated first floor elevation of each house to yield a total stage-damage function. The stage-damage function defines the dollar damages that are estimated to occur at different flooding elevations.

Recurring losses are those potential flooding related losses which are expected to occur at various stages of flooding under the existing development conditions and existing hydrologic conditions. Combining the stage-damage curve that was developed as described above, with the stage frequency curve that was developed in the hydrologic analysis, yields the total flooding damages that are estimated to occur at various flooding levels. The recurring flood losses for a selection of different flood events for the backshore area is shown in the table below.

Recurring Flood Losses
Existing Conditions
Backshore

<u>Flood Probability</u>	<u>Return Frequency (years)</u>	<u>Flood Elevation</u>	<u>Flood Damages</u>
100%	1	3.3	\$ 0
50%	2	4.2	\$ 14,900
20%	5	5.8	\$ 241,800
10%	10	7.8	\$ 1,937,100
5%	20	9.3	\$ 5,599,700
2%	50	11.5	\$13,507,500
1%	100	11.8	\$14,814,200

The final step in the backshore analysis was to calculate the expected annual flood damages for the backshore area. The expected annual damages are calculated by multiplying the recurring loss at each flood elevation by the annual percent chance that each flood elevation will be reached. The resulting expected damages at each event, given each event's probability of occurrence, are then added together to yield the total expected annual flood damages for the backshore area. The expected annual damage figure represents the average annual flood damages that could be expected to occur based on the weighted probabilities of the complete range of flood events. The expected annual flood damages for the backshore area are shown in the table below.

Expected Annual Flood Damages
Existing Conditions
Backshore

<u>Area</u>	<u>Expected Annual Damages</u>
Misquamicut	\$730,300
Breach Dr./Behind Pond	<u>\$149,200</u>
Total	\$879,900

The effectiveness of a flood damage reduction plan is measured by the extent to which it reduces expected annual flood damages. For Alternative A, which includes the construction of dikes to protect the Misquamicut residential area, flood damage reduction benefits are calculated based on the level of protection provided by the dikes, and the amount of annual damages in the Misquamicut residential area that would be prevented at each level of protection. For Alternative B, which includes the dikes as in Alternative A, but also includes a larger beach, flood damage reduction benefits for the Misquamicut residential area are calculated as in Alternative A. Flood damage reduction benefits for the other backshore areas not protected by the dikes, Breach Drive and the low-lying areas behind Winnapaug Pond, are calculated based on the reduction in flood stages that would occur in the study area with the 9200' beach as determined in the hydrologic analysis.

For Alternative C, which includes the construction of the tide gate, flood damage reduction benefits are calculated for the entire backshore area of the study area based on the level of protection provided by the tide gate. For Alternative D, which includes the raising of houses to 1' above the 100 year flood elevation, flood damage reduction benefits were calculated by elevating the stage-damage functions of each house to reflect first floor damages being raised to 1' above the 100 year flood elevation, and comparing the difference in expected annual damages between the raised and existing, not-raised, conditions. The flood damage reduction benefits which would be achieved with each alternative improvement plan, and with each increment of level of protection provided, are shown in the table below.

Annual Flood Damage Reduction Benefits
Backshore

<u>Alternative</u>	<u>Annual Flood Damage Reduction Benefits</u>			
	<u>10 yr plan</u>	<u>25 yr plan</u>	<u>50 yr plan</u>	<u>100 yr plan</u>
Alternative A				
4000' Beach + Dikes	\$132,700	\$341,300	\$501,600	\$613,400
Alternative B				
9200' Beach + Dikes	\$135,100	\$390,500	\$569,000	\$709,200
Alternative C				
9200' Beach + Tide Gate	\$136,600	\$390,800	\$594,100	\$733,800
Alternative D				
9200' Beach + Raise 186 Homes				\$653,500

The annual flood damage reduction benefits for Alternative A are less than those for Alternative B because the longer beach included in Alternative B provides some flood protection, although not complete protection, to the entire study area, including Breach Drive and the areas behind Winnapaug pond, whereas the 4000' beach of Alternative A does not provide any reduction in flood stages to the areas of Breach Drive and behind Winnapaug Pond. The annual flood damage reduction benefits for Alternative C are greater than those for Alternative B, because the tide gate provides more complete flood damage protection to the Breach Drive area and the areas behind Winnapaug Pond than beach provided in Alternative B.

Shorefront Analysis

In the shorefront analysis, the shorefront part of the study area was subdivided into three areas. The first area consists of the commercial area located west of Misquamicut State Beach. This area contains a dense development of business establishments, including hotels, restaurants, snack bars, and shops, which are located on both sides of Atlantic Avenue. The second area consists of Misquamicut State Beach. The third area consists of the commercial area located east of the state beach. This area contains an amusement park, water slide, and additional restaurants, night clubs, snack bars, and shops. A fourth category was used to include clean-up and other storm-related costs incurred by the town of Westerly in severe storms.

As this study was performed at the reconnaissance level of detail, a few simplifying assumptions had to be made. Due to the relative ease of applying the flood damage methodology used in the backshore analysis to residential structures, the residential structures located on both sides of Atlantic Avenue to the west of the west commercial area were included in the backshore analysis instead of in the shorefront analysis. There is also a significant number of residential structures located on both sides of Atlantic Avenue to the east of the east commercial area. The houses on the pond side in this area are primarily small, single family homes which are all built elevated above their garages. The houses on the shore side in this area include many very large,

elaborate homes, many of which are also built elevated, any many of which are located up and behind relatively high dunes. Due to the elevated construction of these houses, and due to the protection provided by the high dunes, these houses to the east of the east commercial area were not included in this analysis. Since the structures which were not included are located relatively high and behind high dunes, they would likely contribute only a very small amount toward total annual storm damages, and thus it was determined that these omissions would most likely not significantly affect the overall economic evaluation and benefit calculations. In a feasibility study, in which more time and resources for analysis would be available, these structures could be surveyed and more information could be developed regarding the susceptibility of these structures to damages.

As the first step in conducting the shorefront analysis, the business owners or managers of the businesses located along Atlantic Avenue were interviewed regarding the amount and type of damages they had experienced in the December 1992 storm and in any other storms. The manager of Misquamicut state beach was also interviewed. The following damages for the different storms that were reported are shown in the table below.

<u>Area</u>	<u>Reported Damages - Shorefront</u>		
	<u>Dec. 1992</u>	<u>March 1993</u>	<u>Hurricane Bob 1991</u>
West Commercial Area	\$202,000	\$ 4,000	\$200,000
East Commercial Area	\$113,000	\$196,000	\$ 0
State Beach	<u>\$ 35,000</u>	<u>\$ 15,400</u>	<u>\$ 5,700</u>
Total	\$350,000	\$215,400	\$205,700

As shown in the above table, the shorefront area suffered damages of at least \$350,000 in the December 1992 event, and suffered nearly as expensive losses in both the March 1993 event and in Hurricane Bob. In total, the area has experienced damages of at least \$771,100 over the past two winter seasons. These figures are the damages that were reported by those business owners or managers that were able to be reached in the damage survey conducted for this analysis. Approximately 90 percent of the business owners in the west commercial area were able to be reached, and approximately 50 percent of the business owners in the east commercial area were able to be reached. In the more detailed feasibility phase of analysis, additional effort could be made to try to collect additional damage data.

In order to calculate the expected annual damages for the shorefront area, the above damage data was combined with the hydrologic data for the shorefront. The damages were correlated with the stage-frequency curve developed for the shorefront zone, in which the stage reflects the level of flow over the shorefront dunes. Based on the hydrologic analysis, the December 1992 event was determined to be approximately a 5 year event, which has 20 percent chance of occurrence. The level of flow over the dunes in the December 1992 event was determined to be near 0, and the curve increases to a maximum flow of 1 foot of water over the dunes at a 100 year event.

While the damages that occurred in the shorefront area with the December 1992 event are known, it is not known what the extent of damages would be at a 100 year event. In order to capture the potential for increased damages at

events more severe than the December 1992 event, an estimate of the maximum damage that would occur with a 100 year event had to be made. For the purpose of this analysis, it was estimated that damages in a 100 year event would be 10 times greater than the damages reported in the December 1992 event. A traditional flood damage analysis program was then used to calculate the expected annual damages for the shorefront area. In addition to the reported damages for the two commercial areas and Misquamicut State Beach, which total \$350,000, the town clean-up and emergency-related costs were also included in this part of the analysis. Based on information provided by the town, an estimate of \$20,000 in clean-up costs was made for the town costs in the December 1992 event, for a total of \$370,000 in total damages with a 5 year event. Multiplying this figure by 10 yields \$3,700,000, which was used as the estimate for the damages that would occur in the shorefront area in a 100 year event. Based on these assumptions, the expected annual storm damages for the shorefront area are shown in the table below.

Expected Annual Storm Damages
Existing Conditions
Shorefront

West Commercial Area	\$227,600
East Commercial Area	\$127,300
State Beach	\$ 39,400
Town Costs	<u>\$ 22,500</u>
Total	\$416,800

The numbers shown above are highly sensitive to the value used for the damage estimate with the 100 year event. The use of 10 times the December 1992 damages, or \$3,700,000, was judged to be a reasonable and even somewhat conservative estimate. In the Hurricanes of 1938 and 1954, many shorefront structures in the study area were completely destroyed. The commercial buildings located on the shore side of Atlantic Avenue only, have an assessed value of \$7.7 million, for the structures only. The estimate of \$3,700,000 is slightly less than half of this assessed value. In addition, a sensitivity analysis was run in which the damage estimate at a 100 year event was varied to determine a likely upper bound and a likely lower bound for the expected annual damage figure. If the assessed value of \$7.7 million is used, expected annual damages rise to \$860,000. If the value is instead assumed to maximize at the value of damages reported in the December 1992 event, the expected annual damages equal \$92,500. The expected annual damage figure of \$416,800 for the shorefront is close to the midpoint between the upper bound and lower bound figures calculated, and so was judged to be reasonable.

In the with project condition, the expected annual storm damages for the shorefront area calculated above would be reduced by the protection provided by the beach. The reductions in storm damages that would be achieved with the different levels of protection examined for each alternative, are derived from the reductions of overwash over the shorefront dunes that would occur with the different levels of protection. Those reductions were determined in the hydrologic analysis. The storm damage reduction benefits are lowest for Alternative A, since that alternative consists of a shorter beach which protects only the commercial area located west of Misquamicut State Beach. The

remaining alternatives, Alternatives B, C, and D, all include the longer, 9200' beach, which protects the commercial areas located both east and west of Misquamicut State Beach, and protects the state beach. As a result, the storm damage reduction benefits for Alternatives B, C, and D are all equal. The annual benefits from storm damage reduction for the shorefront area for each alternative are shown in the table below.

Annual Storm Damage Reduction Benefits
Shorefront

<u>Alternative</u>	<u>Annual Storm Damage Reduction Benefits</u>			
	<u>10 yr plan</u>	<u>25 yr plan</u>	<u>50 yr plan</u>	<u>100 yr plan</u>
Alternative A				
4000' Beach + Dikes	\$ 75,800	\$155,600	\$188,700	\$207,400
Alternative B				
9200' Beach + Dikes	\$138,800	\$285,000	\$345,700	\$379,800
Alternative C				
9200' Beach + Tide Gate	\$138,800	\$285,000	\$345,700	\$379,800
Alternative D				
9200' Beach + Raise 186 Homes				\$379,800

Recreation Analysis

For this analysis, the recreation benefits were evaluated using the Unit Day Value method. Other methods for evaluating recreation benefits approved by the Corps of Engineers include the Travel Cost method and the Contingent Value method. However, these other two methods require significant resources to use, resources not generally available in a reconnaissance level investigation. In using the Unit Day Value method, points are assigned to five characteristics of the recreation activity. The definition of each of the five characteristics, the range of point values, and the guidelines for assigning the point values are contained in Corps of Engineers regulations. Points are assigned for both the without and with project conditions, so that the difference between the two conditions can be calculated. The point totals are converted to dollar values based on a conversion table also contained in current Corps of Engineers guidance. For this analysis, the points were assigned for the without and with project conditions as shown below.

Unit Day Value Point Assignments

<u>Characteristic</u>	<u>Without Project</u>	<u>With Project</u>
Recreation Experience	6	12
Availability of Opportunity	8	8
Carrying Capacity	4	10
Accessibility	16	16
Environmental	4	14
Total	38	60
\$ Conversion	\$4.81	\$5.87

In calculating the recreation benefits, two categories of beneficiaries were identified, current users and new users. With the project, in which additional beach space would be provided, the current users would benefit from the increased beach space. The larger beach would be more esthetic, more comfortable, and would have more space available for beach activities, in comparison to the current beach. In order to calculate the dollar value of the annual benefit for current users, the total number of current users per year (190,000) was calculated by the difference in Unit Day Value between the without and with project conditions ($\$5.87 - \$4.81 = \$1.06$), yielding an annual benefit for current users of \$201,400 ($190,000 \times \$1.06 = \$201,400$).

With the project, the new beach space would increase the capacity and the appeal of the beach, which would likely increase the usage over the current level. This increased usage could include completely new users, or could include an increase in the number of user days by current users. In either case, the total usage is projected to increase. In a reconnaissance study, in which the resources to conduct a recreational demand study are usually not available, it is usually assumed that there is sufficient demand to use all of the newly provided beach space, based on a requirement of 75 square feet per person. However, even with the smallest beach analyzed in this analysis, the beach providing 10 year protection, the total new area provided would provide enough space for more than double the current usage based on a requirement of 75 square feet per person. The 100 year beach alternative would provide space for over three and one-half times the current usage. While the study area does contain a large number of parking spaces, approximately 3000, it was judged that it was not reasonable to project such a large increase in usage. Predicting such a high level of demand over the current level did not seem reasonable and, even if such a high demand did exist, that demand may exceed available parking spaces.

As a result, for this purpose of this analysis, it was estimated that, with the project, the usage would increase 50 percent over the current usage, an increase of 95,000 user days ($190,000 \times .5 = 95,000$). Since sufficient beach space is provided with even the smallest beach alternative examined, Alternative A, based on a requirement of 75 square feet per person, this increased usage benefit was taken for all of the beach alternatives examined.

In order to calculate the dollar value for the annual benefit for this increased usage, the projected number of increased user days with the project (95,000) is multiplied by the with project unit day value (\$5.87), yielding an annual benefit for increased usage of \$557,650 ($95,000 \times \$5.87 = \$557,650$).

Added together, the total annual recreational benefits for both existing users and new users equal \$759,050 ($\$201,400 + \$557,650 = \$759,050$). As explained above, it is estimated in this reconnaissance study that this benefit figure would be achieved with each of the beach alternatives examined. However, current Corps guidance requires that recreational benefits not exceed 50 percent of total project benefits. As a result, the total recreational benefits for each alternative are limited accordingly in the final total benefit calculations, which are shown in the "Benefit Summary" section at the end of this report.

Regional Economic Development Benefits

Misquamicut State Beach and the businesses located along Atlantic Avenue provide a significant amount of economic benefits to the economy of the town and the economy of the region. The economy of the region would be seriously hurt were the businesses on Atlantic Avenue to suffer a decrease in business, or particularly if they were lost completely due to storm damages. As a result, the town of Westerly views the protection of those business and the protection of the quality and size of Misquamicut State Beach as crucial to the economic health of the town and region. According to sources quoted in local newspaper reports regarding the damages experienced in the study area in the past winter, the visitors to the beach and beach-related attractions of the study area bring an estimated \$70 million into the economy of the region.

While the extreme economic importance of the resources of the study area to the economy of the region is clear, according to Corps of Engineers regulations, these benefits are classified as Regional Economic Development benefits, not National Economic Development benefits, and only National Economic Development benefits are currently allowed to be counted toward project justification. Since the Corps is a federal agency, the Corps analysis is done from the national perspective. In general terms, in taking the national perspective, it is assumed that those tourist dollars spent at Misquamicut, and the resulting multiplier effects to the regional economy, were they not spent at Misquamicut, would most likely be spent in another area, having similar multiplier effects in that region. Or, conversely, if the Misquamicut area enjoyed an increase in tourist expenditures, those tourist dollars and the corresponding multiplier effects in the regional economy would be offset by corresponding losses in another area or region. One region's loss would be another region's gain, or vice versa, and the two effects would cancel each other out in terms of the national economy. As a result, the economic benefits that the businesses in the study area bring to the economies of the town and region are viewed as Regional Economic Development benefits, not National Economic Development benefits. Since the regional benefits are not able to be counted toward project justification, these benefits were not examined further in this analysis.

Benefit Summary

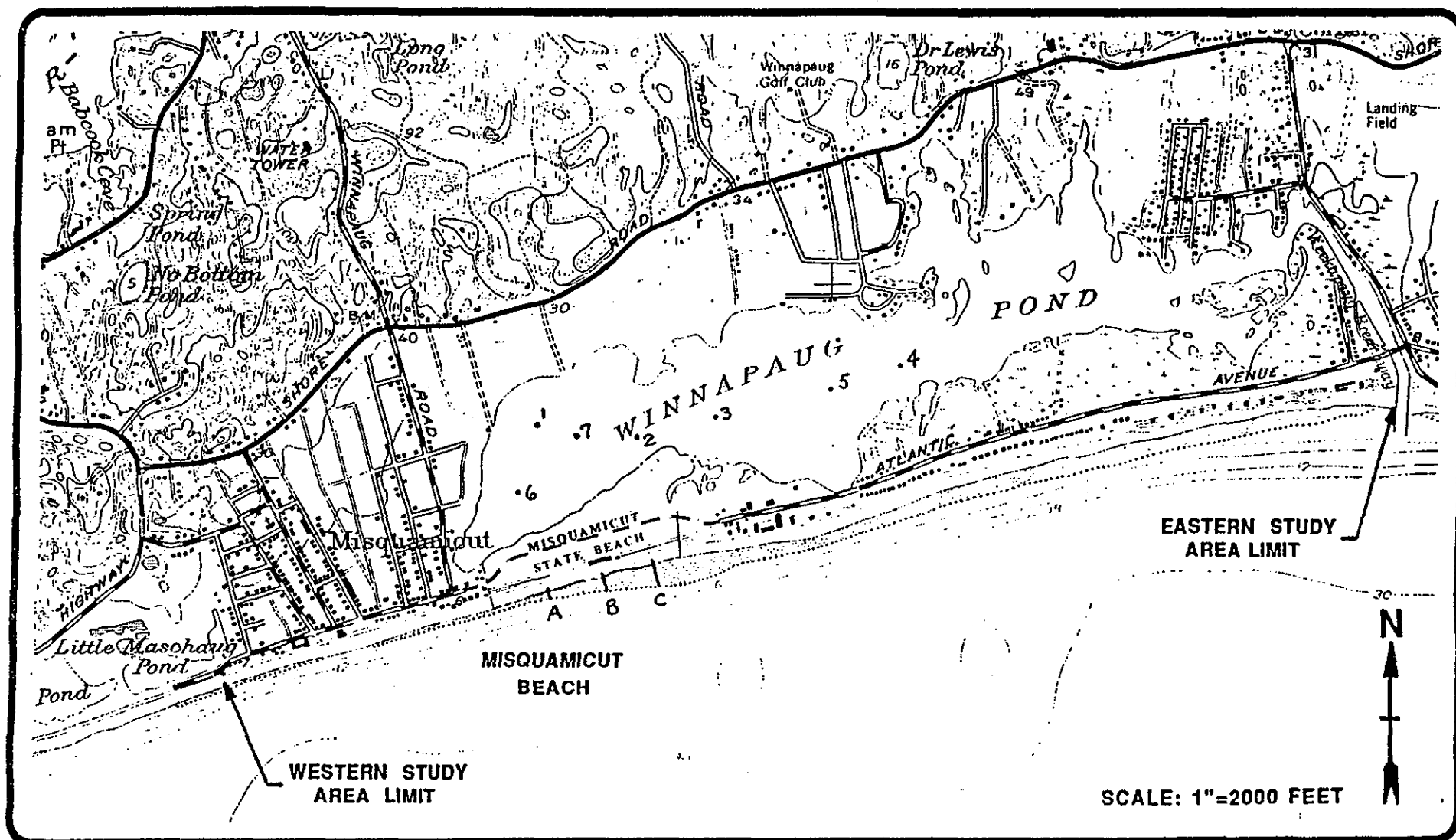
The annual benefits for each alternative improvement plan examined are shown in the table below. The annual flood damage reduction benefits, the annual storm damage reduction benefits, the annual recreation benefits, and the total annual benefits are shown.

Misquamicut Beach
Westerly, RI
Benefit Summary

<u>Plan</u>	<u>Annual Benefits Backshore</u>	<u>Annual Benefits Shorefront</u>	<u>Annual Recreation Benefits*</u>	<u>Total Annual Benefits</u>
Alternative A - 4000' Beach + Dikes				
10 yr plan	\$132,700	\$ 75,800	\$208,500	\$ 417,000
25 yr plan	\$341,300	\$155,600	\$496,900	\$ 993,800
50 yr plan	\$501,600	\$188,700	\$690,300	\$1,380,600
100 yr plan	\$613,400	\$207,400	\$759,050	\$1,579,850
Alternative B - 9200' Beach + Dikes				
10 yr plan	\$135,100	\$138,800	\$273,900	\$ 547,800
25 yr plan	\$390,500	\$285,000	\$675,500	\$1,351,000
50 yr plan	\$569,000	\$345,700	\$759,050	\$1,673,750
100 yr plan	\$709,200	\$379,800	\$759,050	\$1,848,050
Alternative C - 9200' Beach + Tide Gate				
10 yr plan	\$136,600	\$138,800	\$275,400	\$ 550,800
25 yr plan	\$390,800	\$285,000	\$675,800	\$1,351,600
50 yr plan	\$594,100	\$345,700	\$759,050	\$1,698,850
100 yr plan	\$733,800	\$379,800	\$759,050	\$1,872,650
Alternative D - 9200' Beach + Raise 186 Homes				
100 yr plan	\$653,500	\$379,800	\$759,050	\$1,792,350

* Total annual recreation benefits equal \$759,050, but recreational benefits claimed are limited to 50 percent of total benefits

APPENDIX D
GEOTECHNICAL LOGS



A, B, C : Beach Sample Locations

1, 2, 3, ... : Boring Locations

SHORE PROTECTION & EROSION CONTROL

SUBSURFACE EXPLORATIONS - 1993

MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND



US Army Corps
of Engineers
New England Division

MISQUAMICUT BEACH, WESTERLY, RI

ATTACHMENT A

GRADATION OF EXISTING BEACH SAND



Professional Service Industries, Inc.

August 18, 1993

Report No. 446-30310-1

Mr. Michael Carroll
Dept. of the Army
N.E. Division, Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Re: Misquamicut Beach
Westerly, RI

Gentlemen:

The following are test results of samples of soils as delivered to this laboratory on 8/16/93:

1. Sample Description

<u>Sample Number</u>	<u>Description</u>	<u>Source</u>
C-519a	Sand	Location A, mid tide
C-519b	Sand	Location B, just below high tide
C-519c	Sand	Location B, mid tide
C-519d	Sand	Location C, mid tide

2. Washed Sieve Analysis (% passing by weight)

<u>Sieve Size</u>	<u>C-519a</u>	<u>C-519b</u>	<u>C-519c</u>	<u>C-519d</u>
3/4"		100		
1/2		97		
3/8		93	100	
#4	100	87	99	100
10	97	79	98	100
40	73	26	75	64
100	2	1	2	1
200	0.2	0.3	0.1	0.2

Should you have any questions or require additional information, please do not hesitate to call.

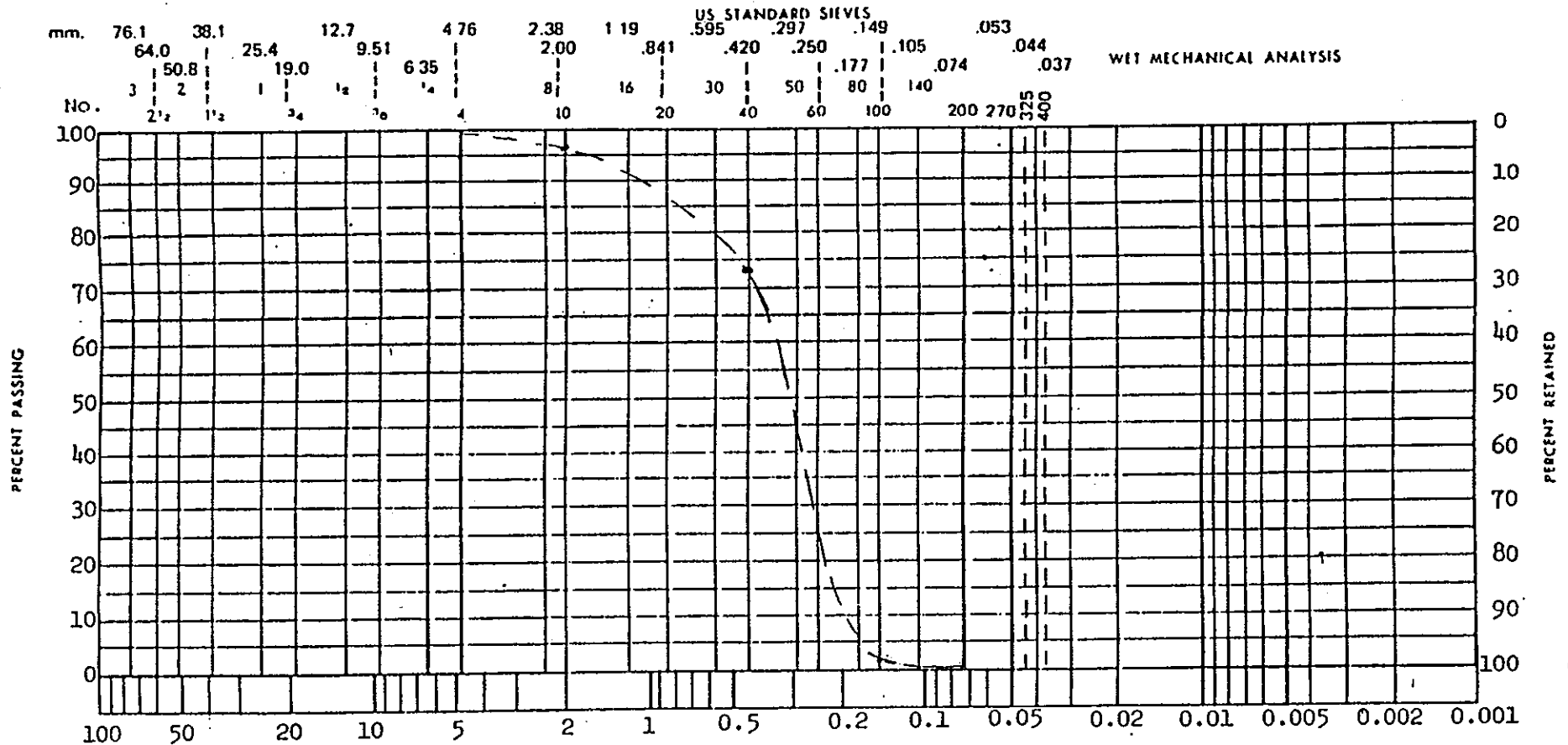
Sincerely,

Thomas Bowker
Division Manager

TB/mm

Grain Size Distribution Graph - Aggregate Grading Chart

PROJECT: <i>Misquanicut Beach</i>	DATE: <i>8/18/93</i>
LOCATION A - MID-TIDE	
SAMPLE NO.: <i>C-519a</i>	TECHNICIAN: <i>TB</i>

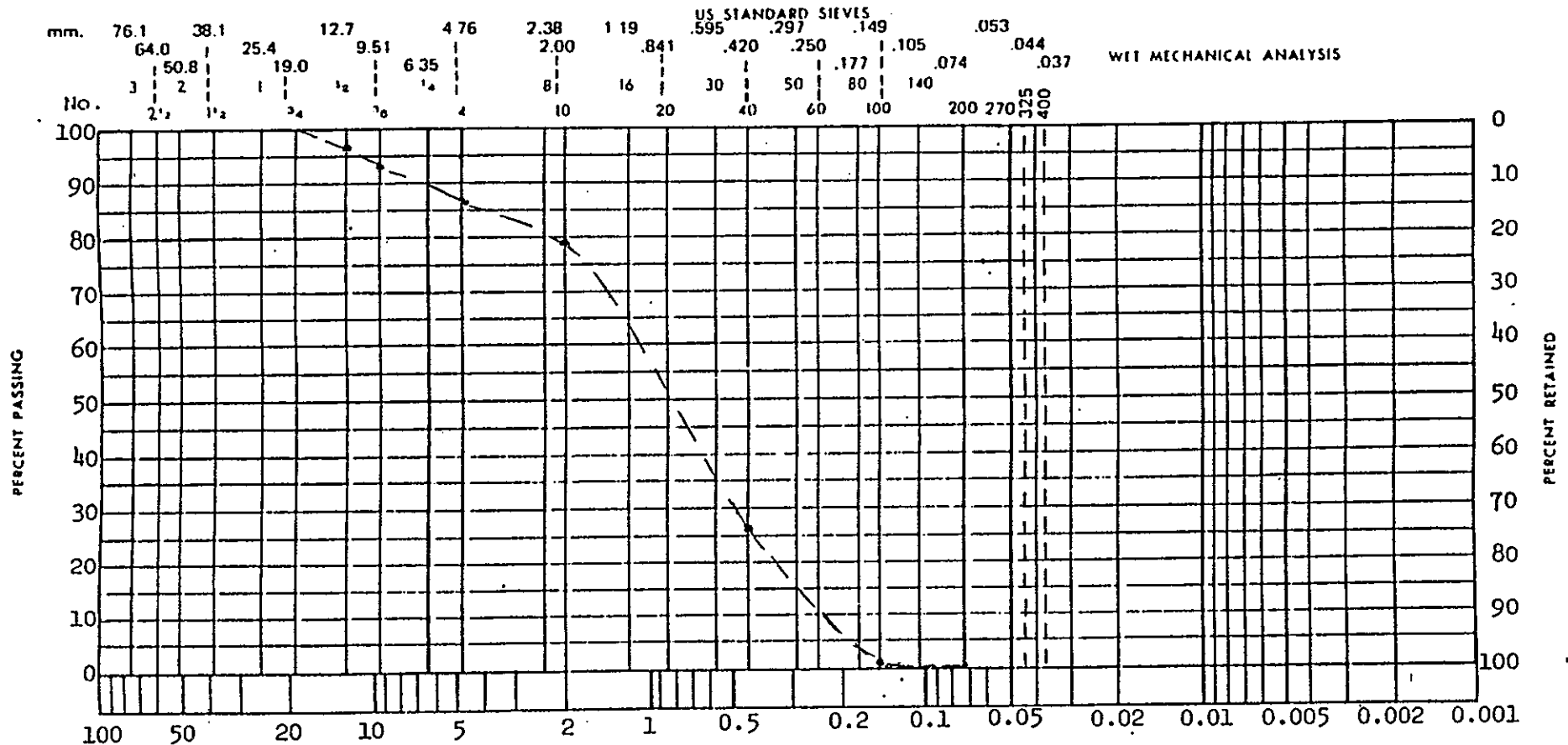


Cobbles	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	Colloids
	Gravel		Sand					

Grain Size Distribution Graph - Aggregate Grading Chart

1

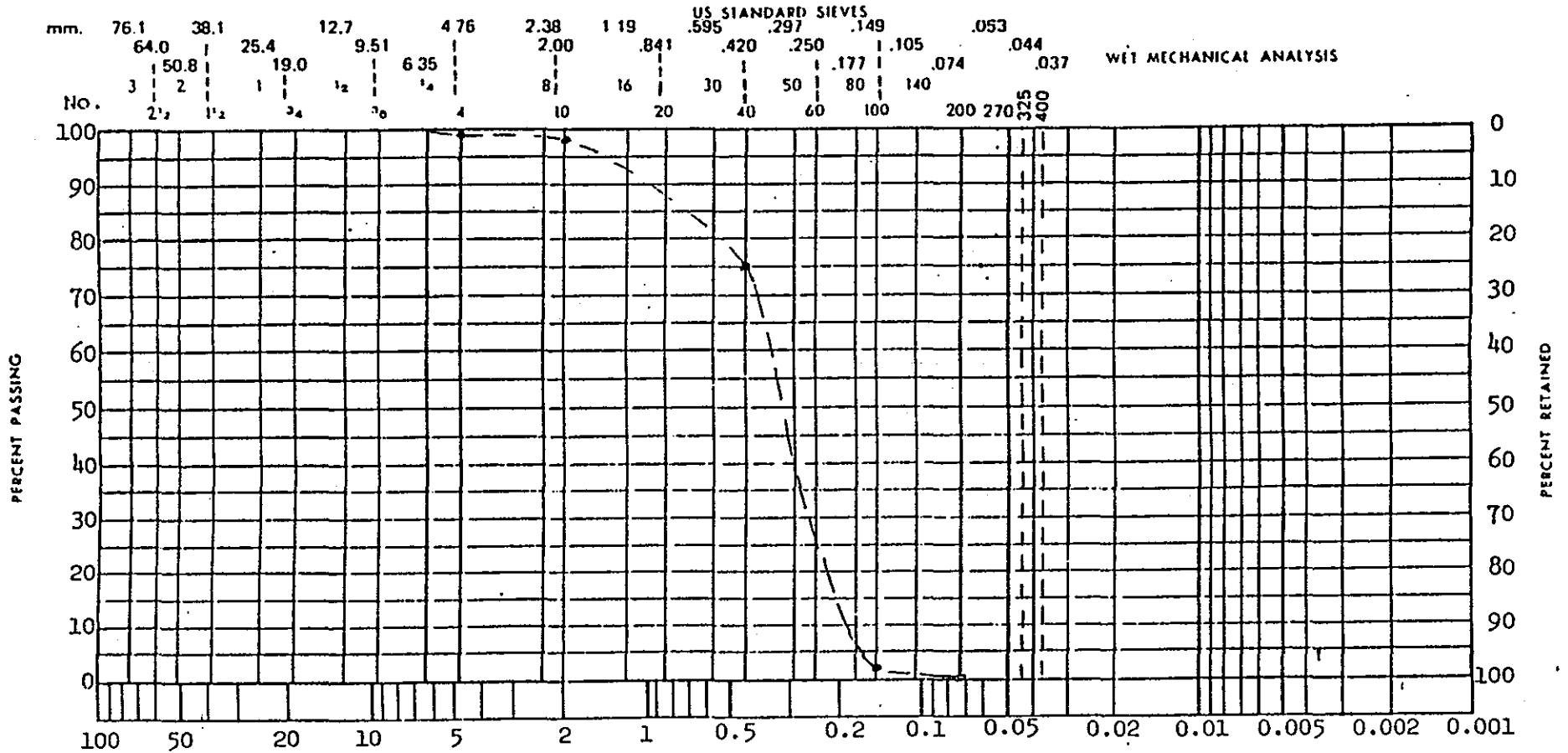
PROJECT: <i>Misquamicut Beach</i>	DATE: <i>8/18/93</i>
LOCATION <i>B - Just Below High-Tide</i>	TECHNICIAN: <i>TB</i>
SAMPLE NO.: <i>C-5196</i>	



Cobbles	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	Colloids
	Gravel		Sand					

Grain Size Distribution Graph - Aggregate Grading Chart

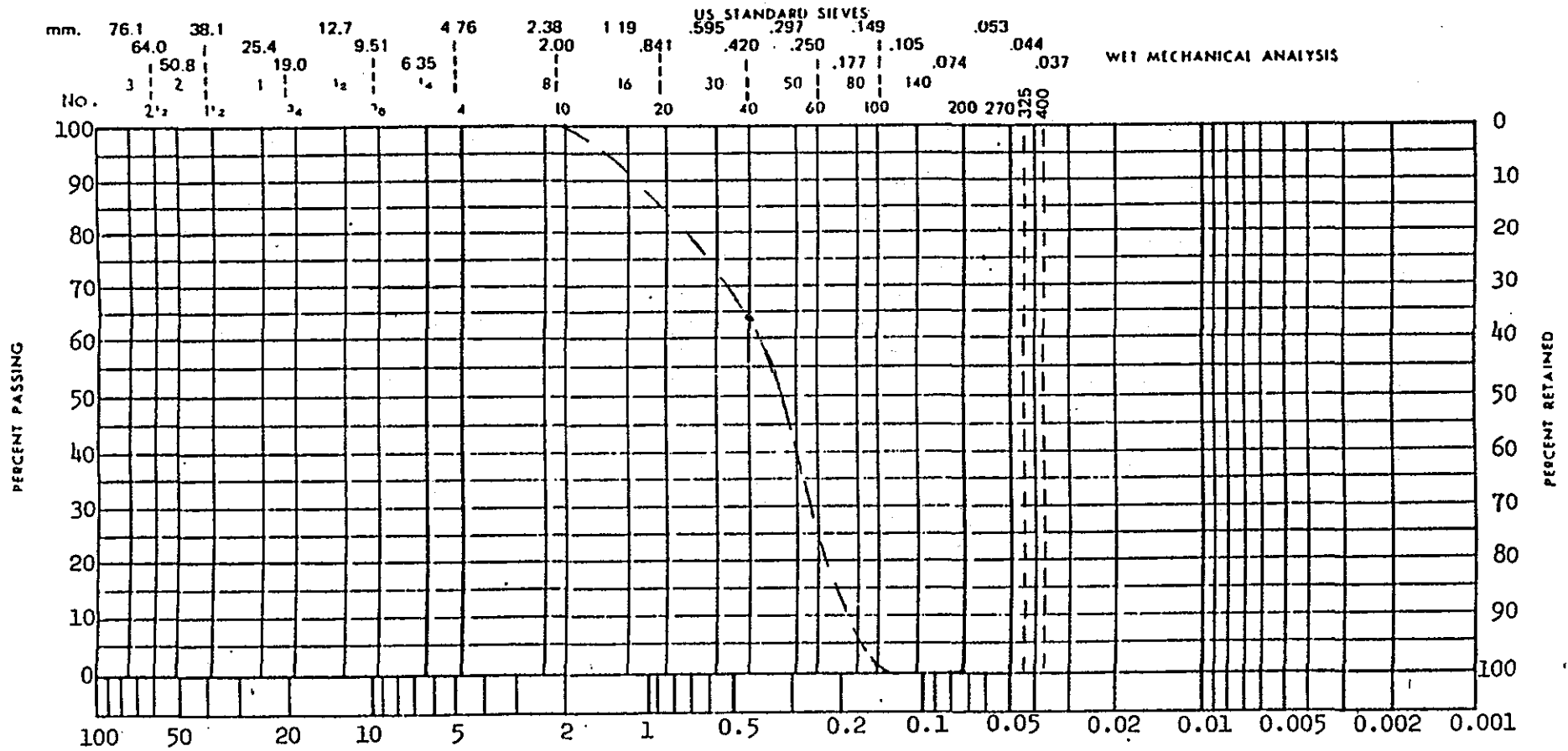
PROJECT: <i>Misquomicut Beach</i>	DATE: <i>Aug 18, 1993</i>
LOCATION <i>B - MID-TIDE</i>	
SAMPLE NO.: <i>C-519C</i>	TECHNICIAN: <i>TB</i>



Cobbles	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	Colloids
	Gravel		Sand					

Grain Size Distribution Graph - Aggregate Grading Chart

PROJECT: <i>Misquamicut Beach</i>	DATE: <i>8/18/93</i>
LOCATION <i>C - MID-TIDE</i>	TECHNICIAN: <i>TB</i>
SAMPLE NO.: <i>C-519d</i>	



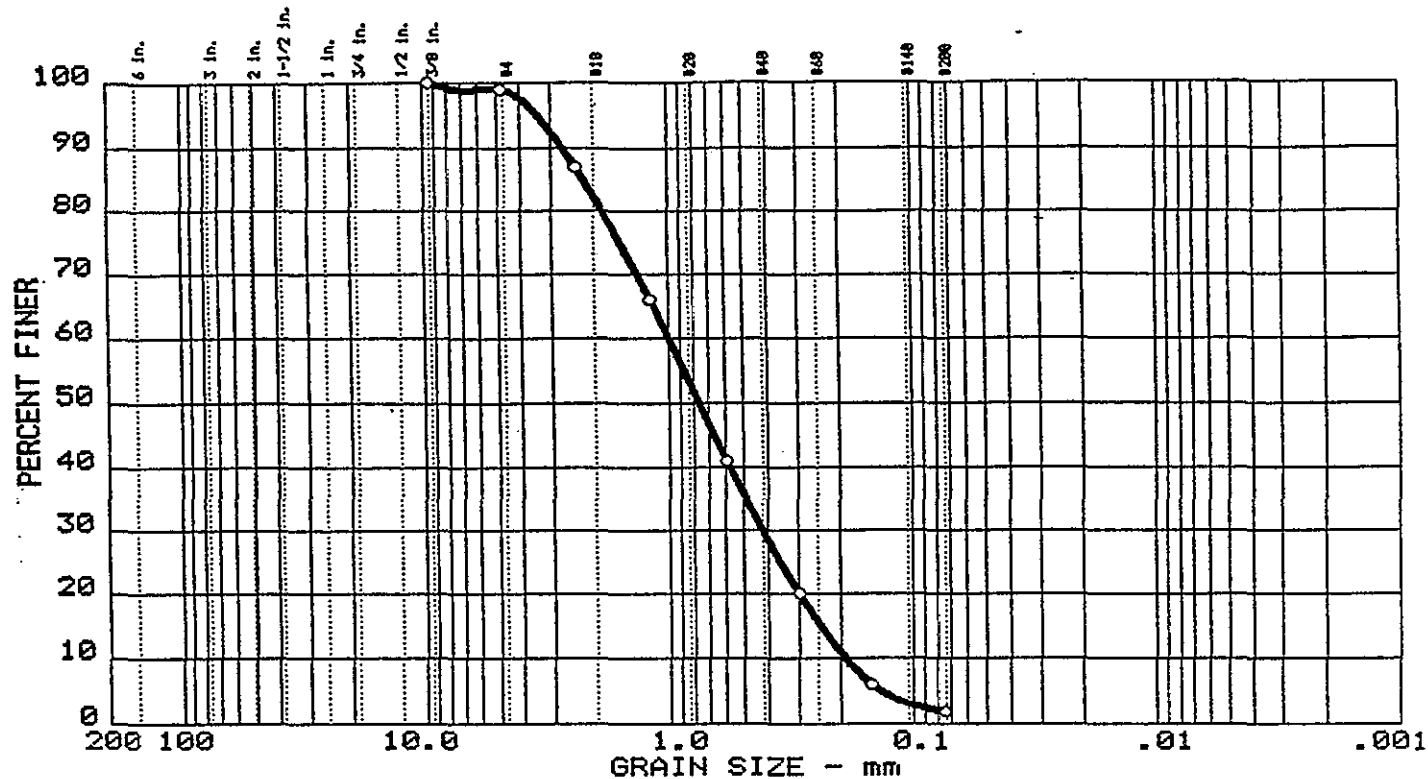
Cobbles	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay	Colloids
	Gravel		Sand					

MISQUAMICUT BEACH, WESTERLY, RI

ATTACHMENT B

GRADATION OF SUPPLIERS SAND

GRAIN SIZE DISTRIBUTION



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
1	0.0	1.0	97.0	2.0	

LL	PI	D75	D60	D50	D30	D25	D10	Cc	Cu
		1.57	1.00	0.76	0.421	0.3540	0.1921	0.92	5.2

MATERIAL DESCRIPTION	USCS	AASHTO
POORLY GRADED SAND	SP	

Project No.:
Project:
Location:

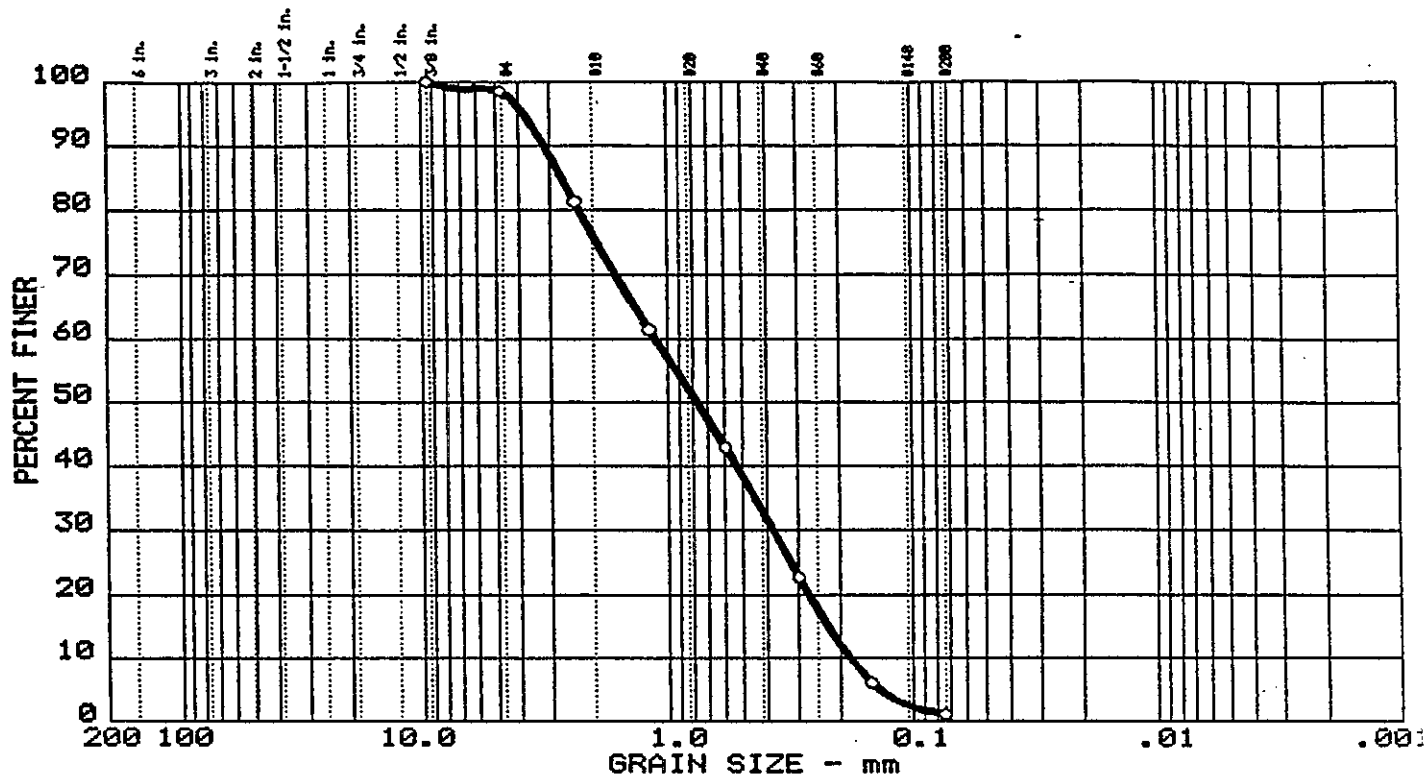
Date: 11-5-93

GRAIN SIZE DISTRIBUTION TEST REPORT
CORPS OF ENGINEERS - NEW ENGLAND

Remarks:

Fig. No.8-1

GRAIN SIZE DISTRIBUTION



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
2	0.0	1.5	97.4	1.1	

LL	PI	D ₇₅	D ₆₀	D ₅₀	D ₃₀	D ₂₅	D ₁₀	C _c	C _u
		1.93	1.12	0.77	0.378	0.3184	0.1830	0.70	6.1

MATERIAL DESCRIPTION	USCS	AASHTO
POORLY GRADED SAND	SP	

Project No.: Project: Location:	Remarks:
Date: 11-5-93	
GRAIN SIZE DISTRIBUTION TEST REPORT CORPS OF ENGINEERS - NEW ENGLAND	

Fig. No.8-2

Grain size distribution curve showing Percent Finer (Y-axis, 0 to 100) versus Grain Size in mm (X-axis, logarithmic scale from 200 to 0.075). The curve indicates a well-graded soil with a peak of 100% finer at 2.0 mm and a sharp drop to approximately 5% finer at 0.075 mm.

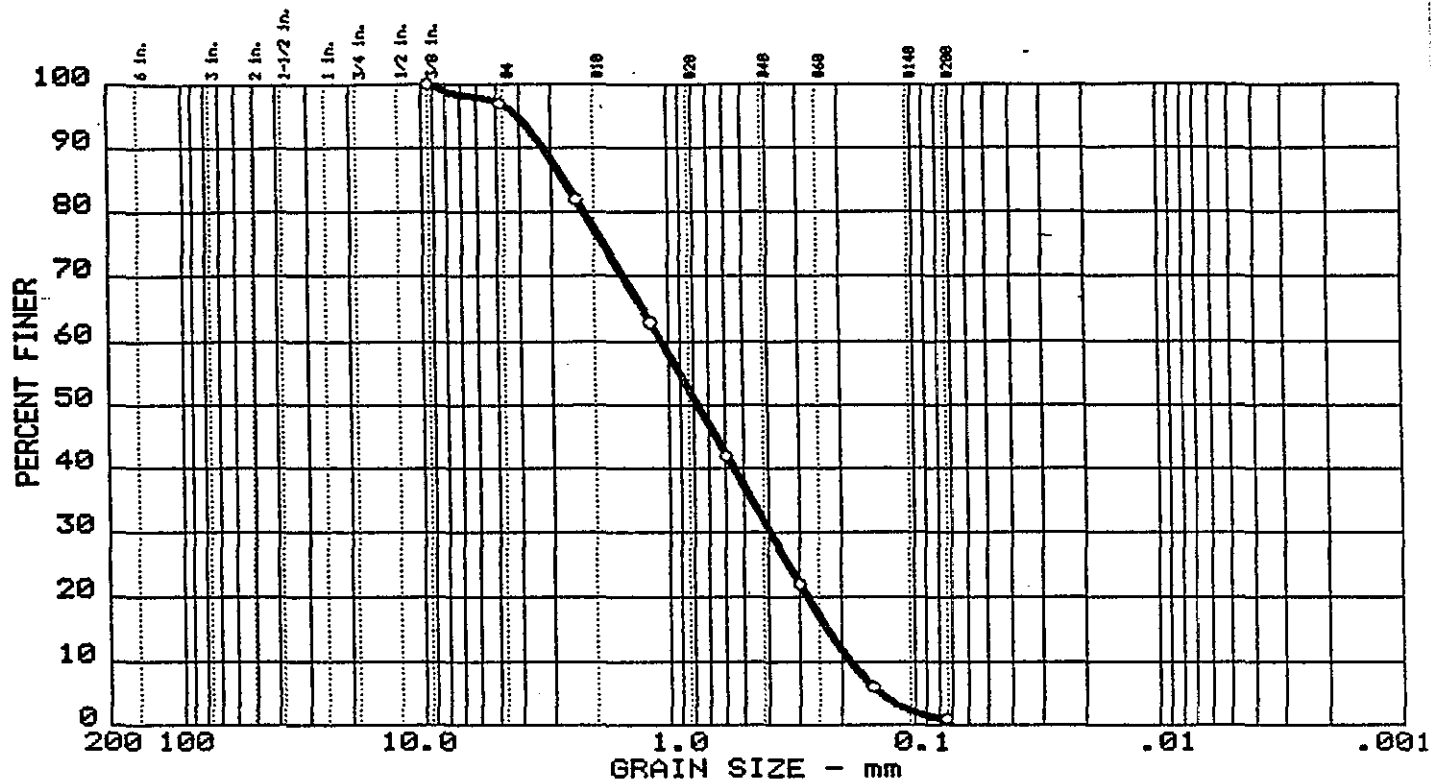
Grain Size (mm)	Percent Finer (%)
200	100
100	100
60	100
40	100
30	100
25	100
20	100
15	100
12.5	100
10	100
7.5	100
6	100
4.75	100
3.75	100
3.0	100
2.5	100
2.0	100
1.5	98
1.18	95
0.85	88
0.75	80
0.6	65
0.425	20
0.3	10
0.25	8
0.2	5

[illegible]

Project No.: Project: o Location: Date: 11-5-93	Remarks:
GRAIN SIZE DISTRIBUTION TEST REPORT CORPS OF ENGINEERS - NEW ENGLAND	Fig. No.8-3

Fig. No.8-3

GRAIN SIZE DISTRIBUTION



Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
4	0.0	3.0	96.0	1.0	

LL	PI	D75	D60	D50	D30	D25	D10	Cc	Cu
		1.84	1.07	0.77	0.393	0.3304	0.1837	0.79	5.8

MATERIAL DESCRIPTION	USCS	AASHTO
POORLY GRADED SAND	SP	

Project No.: Project: Location:	Remarks:
Date: 11-5-93	
GRAIN SIZE DISTRIBUTION TEST REPORT CORPS OF ENGINEERS - NEW ENGLAND	

Fig. No. 84

MISQUAMICUT BEACH, WESTERLY, RI

ATTACHMENT C

WINNAPAUG POND BORING FIELD LOGS

FIELD LOG OF TEST BORING

Elevation Top of Boring -4.2 NGVD Hammer Wt. 140 lb Boring Started 9/7/93
Total Overburden Drilled 5.0 Feet Hammer Drop 30 in.
Elevation Top of Rock - M.S.L. Casing Left - Boring Completed 9/7/93
Total Rock Drilled - Feet Subsurface Water Data - Page -
Elevation Bottom of Boring -9.2 NGVD Obs. Well -
Total Depth of Boring 5.0 Feet Drilled By PAUL DAVIS, ROB PRICE
Core Recovered - % No. Boxes - Mfg. Des. Drill CME 45 SKORIG
Core Recovered - Ft : - Diam. - In. Inspected By T. ELDRIDGE
Soil Samples 2 1/2 In. Diam. 4 No. Classification By T. ELDRIDGE
Soil Samples - In. Diam. - No. Classification By -

DEPTH		CORE/SAMPLE		BLOWS PER FT	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	ft	NO.	SIZE	DEPTH RANGE		
-4.2		S-1A		0.0	140 lb. HAMMER 18 in. DROP NW ROD 2 1/2" SPLIT SPOON	S-1A: Dk. olive, silty (20-30) F. SAND, trace organics, sl. odor. (SM)
-5.2	1			1		
				2.0	3	
					SPUN/WASHED CASING 2.0 FT. TO -6.2 NGVD EASY DRILLING	1.6' (-5.8)
-6.2	2	S-1B		16		S-1B: Dk. olive m.-c. SAND, trace silt, some gravel pieces.
		S-2		2.0	8	2.0' - - - - - (SP) - -
				TO	25	S-2: Med. olive, f.-c. sandy.
-7.2	3			4.0	31	(35-45) f.-c. GRAVEL, tr. silt. (GP)
					ROLLER BIT TO -8.2 NGVD WASH CASING - RELATIVELY DIFFICULT DRILLING	
-8.2	4	S-3		33		S-3: Same.
				4.0	50	
				TO	83	5.0' END OF BORING
-9.2	5			5.0	BORING REFUSAL @ -9.2 NGVD	
-10.2	6					
-11.2	7					
-12.2	8					
-13.2	9					
-14.2	10					

GENERAL REMARKS:
NGVD = NATIONAL GEODETIC VERTICAL DATUM
DRILL STEM STABILIZED @ 5" I.D. 3 FT. LENGTH STEEL CASING

test
S-2

sandy (43%)
GRAVEL w/
silt (6.7%)
SP-GM)

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

Site WINNAPPAUG POND Page 1 of 2 pages

Boring No. FD93-2 Desig. FD93-B Diam. (Casing) 4" HW

FIELD LOG OF TEST BORING

Co-ordinates: N 89038.0 E 417111.3

Elevation Top of Boring -4.2 N6VD Hammer Wt. 140 lb Boring Started 9/8/93
Total Overburden Drilled 15.0 Feet Hammer Drop 30 IN
Elevation Top of Rock — M.S.L. Casing Left: — Boring Completed 9/8/93
Total Rock Drilled — Feet Subsurface Water Date — Page —
Elevation Bottom of Boring -19.2 M.S.L. Obs. Well —
Total Depth of Boring 15.0 N6VD Drilled By PAUL DAVIS, ROB PRICE
Core Recovered — % No. Boxes — Mfg. Des. Drill CME 45' SLID RIG
Core Recovered — Ft. — Diam. — In. Inspected By: T. ELDRIDGE
Soil Samples 2 1/2 In. Diam. 10 No. Classification By: T. ELDRIDGE
Soil Samples — In. Diam. — No. Classification By: —

DEPTH	CORE/SAMPLE		BLOWS PER FT	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	NO.	SIZE			
-4.2	0		2	140 lb HAMMER 30 IN DROP	S-1: Dk. olive, silty
			3	NW ROD 2 1/2" I.D. SPLIT SPOON	(20-30) F. SAND, tr.
-5.2	1		3		organics.
-6.2	2		1	WEIGHT OF ROD SPOON SETTLED TO -3 FT.	
				SPOON/WASHED CASING TO	
-7.2	3			-7.2 N6VD	
	S-2A		1	140 lb HAMMER 30 IN DROP	S-2A: Dk. olive SILT,
-8.2	4		5	NW ROD 2 1/2" SPLIT SPOON	little f. sand (S-15), tr. organics.
	S-2B		9	SPOON/WASHED CASING TO	S-2B: Med. olive, M. SAND (SP)
-9.2	5		10	-9.2' N6VD	
	S-3A			1/2 throttle - 3RD GEAR	S-3A: Med. olive, M.C. SAND (SP)
-10.2	6		3	140 lb HAMMER 30 IN DROP	
			7	NW ROD 2 1/2" SPLIT SPOON	
-11.2	7		28	SPOON/WASHED CASING TO	S-3B: Olive, M. GRAVEL w/ f.-c.
	S-3B		47	-11.2' N6VD	sand (30-40), tr. sil. (GP)
				RELATIVELY DIFFICULT DRILLING	S-4A: Olive gray, M-C GRAVEL,
-12.2	8		41	140 lb HAMMER 30 IN DROP	w/ f.-c. sand (10-20).
	S-4A		40	NW ROD 2 1/2" SPLIT SPOON	
-13.2	9		46	SPOON/WASHED CASING TO	S-4B: Olive, C. SAND, little
	S-4B		46	-13.2' N6VD	f.-m. gravel (0-10), (SP).
	S-5		32	140 lb. HAMMER 30 IN DROP	S-5: Olive, C. SAND, some
			43	NW ROD 2 1/2" SPLIT SPOON	f.-c. gravel (5-15). (SP)

GENERAL REMARKS:
N6VD = NATIONAL GEODETIC VERTICAL DATUM

S-5:

DEPTH		CORE/SAMPLE		BLOWS PER FT		SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	Feet	NO.	SIZE	DEPTH RANGE	CORE RECVY		
-14.2		S-5		9.0 To	42	SPUN/WASHED CASING TO -15.2' NBVD	
-15.2	11	S-6		11.0 To	35 29 22	140 lb HAMMER 30 IN DROP NWRD 2 1/2" I.D. SPLIT SPECN	S-6: Olive, C. SAND, little f.-m. gravel pieces (0-10), (SP).
-16.2	12			13.0 To	20 18	SPUN/WASHED CASING TO -17.2' NBVD	
-17.2	13	S-7		13.0 To	22 17	140 lb HAMMER 30 IN DROP NWRD 2 1/2" I.D. SPLIT SPECN	S-7: Olive, C. SAND, some f.-m. gravel (5-15), (SP).
-18.2	14			15.0 To	16		
-19.2	15				15	BORING TERMINATED @ -19.2' NBVD	

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

Site WINNAPAU POND Page 1 of 2 pages

Boring No. FD93-3 Desig FD93-D Diam. (Casing) 4" HW

FIELD LOG OF TEST BORING

Co-ordinates: N 89277.1 E 418203.5

Elevation Top of Boring -3.8 NGVD Hammer Wt. 140 lb Boring Started 9/8/93
Total Overburden Drilled 15.0 Feet Hammer Drop 30 IN
Elevation Top of Rock - M.S.L. Casing Left - Boring Completed 9/8/93
Total Rock Drilled - Feet Subsurface Water Date - Page -
Elevation Bottom of Boring -18.8 NGVD Obs. Well -
Total Depth of Boring 15.0 Feet Drilled By PAUL DAVIS, ROB PRICE
Core Recovered - % No. Boxes - Mfg. Des. Drill CME 45 SKID RIG
Core Recovered - Ft : - Diam. - In. Inspected By: T. ELDRIDGE
Soil Samples 2 1/2 In. Diam. 10 No. Classification By: T. ELDRIDGE
Soil Samples - In. Diam. - No. Classification By: -

DEPTH	CORE/SAMPLE			BLOWS PER FT	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	NO.	SIZE	DEPTH RANGE			
-3.8	0	S-1A	0.0	TO 6	140 lb HAMMER 30 IN DROP NW ROD 2 1/2" I.D. SPLIT SPOON	S-1A: Dk. olive F. SAND, some silt (10-20), strong odor (SM).
-4.8	1			2		
-5.8	2		3.0	2	SPIN/WASHED CASING TO -6.8' NGVD	2' (estimated)
-6.8	3	S-1B				S-1B: Olive, F. SAND, tr. silt (SP).
-7.8	4	S-2	3.0	3	140 lb. HAMMER 30 IN DROP NW ROD 2 1/2" I.D. SPLIT SPOON	S-2: Olive gray F.-M. SAND, tr. silt. (SP)
-8.8	5		TO	2		
-9.8	6	S-3A	5.0	1	140 lb. HAMMER 30 IN DROP NW ROD 2 1/2" I.D. SPLIT SPOON	S-3A: Olive gray F. SAND, tr. silt (SP).
-10.8	7	S-3B	TO	1	SPIN/WASHED CASING TO -10.8' NGVD 1/2" THROTTLER 3RD GEAR	6.2' Dk. S-3B: Olive, F. SAND, some silt (10-20), (SP/SM).
-11.8	8	S-4	7.0	2	140 lb HAMMER 30 IN DROP NW ROD 2 1/2" I.D. SPLIT SPOON	S-4: Dk. olive, F. SAND, tr. silt (0-5), (SP)
-12.8	9		TO	1	SPIN & WASHED CASING TO -12.8' NGVD EASY DRILLING	8.9' 1" Peaty Layer @ bottom of S-4
-13.8	10	S-5A	9.0	W	140 lb HAMMER 30 IN DROP NW ROD 2 1/2" I.D. SPLIT SPOON	S-5A: Blackish bn. peaty SILT, abun. v. small roots, stems, woody matter, tr. sand. (PT/OM)
			TO	Z		9.8' S-5B: Olive ... see next sheet

GENERAL REMARKS:

NGVD = NATIONAL GEODETIC VERTICAL DATUM

DRILL STEM STABILIZED IN WATER WITH 5" I.D. 3 FEET
LENGTH STEEL CASING

DEPTH		CORE/SAMPLE		BLWDS PER FT	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
1"	NO.	SIZE	DEPTH RANGE	CORE RECVY		
-13.8	10	S-5B	9.0 TO	1	SPONGE WASHED CASING TO -14.8' NVD	9.8' Olive, SILT, some f.-c. sand (20-30)
-14.8	11	S-6	11.0 TO	1 WOR	140 lb HAMMER 30 IN DROP NW ROD 2 1/2" SPLIT SPOON	11' - - - (SM/OM) S-6: Olive, f.-m. SAND, some silt (15-25), (SM).
-15.8	12		12.0 TO	12		
-16.8	13	S-7	13.0 TO	17 10	140 lb HAMMER 30 IN DROP NW ROD 2 1/2" SPLIT SPOON	13' - - - S-7: Olive, c. SAND, trace gravel (SP)
-17.8	14		14.0 TO	9		
-18.8	15		15.0 TO	16		
				24	BORING TERMINATED @ -18.8' NVD	15' END OF BORING

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

Site WINNAPPAUG POND - BORING Page 1 of 2 pages

Boring No. FD93-4 Desig. FD93-E Diam. (Casing) 4" HW

FIELD LOG OF TEST BORING

Co-ordinates: N 90138.0 E 420867.0

Elevation Top of Boring -1.1' NGVD Hammer Wt. 140 lb Boring Started 9/8/93
Total Overburden Drilled 14.0 Feet Hammer Drop 30 in Boring Completed 9/8/93
Elevation Top of Rock - M.S.L. Casing Left -
Total Rock Drilled - Feet Subsurface Water Date - Page -
Elevation Bottom of Boring -15.1 NGVD Obs. Well -
Total Depth of Boring 14.0 Feet Drilled By PAUL DAVIS ROB PRICE
Core Recovered - % No. Boxes - Mfg. Des. Drill CME 45 SKID RIG
Core Recovered - Ft : - Diam. - In. Inspected By T. ELORIOBE
Soil Samples 2 1/2 In. Diam. 6 No. Classification By T. ELORIOBE
Soil Samples - In. Diam. - No. Classification By -

DEPTH		CORE/SAMPLE		BLOWS PER FT	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
ft	NO.	SIZE	DEPTH RANGE	CORE RECVY		
0	S-1		0.0	5	140 lb HAMMER 30 IN DROP NW ROD 2 1/2" I.D. SPLIT SPOON	S-1: Olive gray, F.-M. SAND, strong odor (SP). (organics) some black matter
-2.1			To	5		
			2.0	3	SPUN & WASHED CASING TO -3.1' NGVD ALSO USED ROLLER BIT TO CLEAN	
-3.1	S-2		2.0	2	140 lb HAMMER 30 IN DROP NW ROD 2 1/2" I.D. SPLIT SPOON	S-2: Olive gray, F.-M. SAND, tr. organic silt, strong odor (organics), (SP)
-4.1			To	3		
			4.0	7	SPUN & WASHED CASING TO -5.1' NGVD	some black matter
-5.1	S-3		4.0	4	140 lb HAMMER 30 IN DROP NW ROD 2 1/2" I.D. SPLIT SPOON	S-3: Gray, M. SAND, tr. organic silt, strong odor (organics) (SP).
-6.1			To	4		
			6.0	4	SPUN & WASHED CASING TO -7.1' NGVD	
-7.1	S-4		6.0	3	140 lb HAMMER 30 IN DROP NW ROD 2 1/2" I.D. SPLIT SPOON	S-4: (3" rec.) Gray, M. SAND, sh. odor, (SP).
-8.1			To	3		
			8.0	2	SPUN & WASHED CASING TO -9.1' NGVD	
-9.1	S-5A		8.0	2	140 lb HAMMER 30 IN DROP NW ROD 2 1/2" I.D. SPLIT SPOON	S-5A: Dk. gray organic SILT, some m.-f. sand, strong H ₂ S odor (SM/OM)
-10.1			To	2		
			10.0	3	SPUN & WASHED CASING TO -11.1' NGVD	
-11.1	S-5B		10.0	2		S-5B: Gray, f.-m. SAND, trace dk. gray organic silt (SP).

GENERAL REMARKS:
NGVD = NATIONAL GEODETIC VERTICAL DATUM

GENERAL REMARKS:

NGVD = NATIONAL GEODETIC VERTICAL DATUM
CASING PERIODICALLY CLEANED WITH ROLLER BIT AND
WASHED CLEAR

2.12

DEPTH	CORE/SAMPLE			BLOWS PER FT CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	NO.	SIZE	DEPTH RANGE			
-11.1	10	S-6	10.0	2	140 LB HAMMER 30 IN DROP NW R00 2 1/2" SPLIT SPOON	S-6: Olive gray + Gray F.M. SAND, trace dk. gray organic silt + (SP) (same as S-5B)
-12.1	11		TO	2		
			12.0	7		
				3		
-13.1	12	S-7	12.0	2	140 LB HAMMER 30 IN DROP NW R00 2 1/2" SPLIT SPOON	S-7: Olive gray F-M SAND, some organic silt (20-30%)
-14.1	13		TO	2		
			14.0	7		
-15.1	14			4	BORING TERMINATED @ -15.1	14.0' END OF BORING
	15					

NED Form 58A (Test)

Boring No. FD 93-4-E

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

Site WINNAPPAUG POND Page 1 of 2 pages

Boring No. FD93-5 Design FD93-C Diam. (Casing) 4" HW

FIELD LOG OF TEST BORING

Co-ordinates: N _____ E _____

Elevation Top of Boring -2-2 NGVD
Total Overburden Drilled 11-3 Feet
Elevation Top of Rock --- M.S.L.
Total Rock Drilled --- Feet
Elevation Bottom of Boring -13-5 NGVD
Total Depth of Boring 11-3 Feet
Core Recovered --- % No. Boxes ---
Core Recovered --- Ft : --- Diam. --- In.
Soil Samples 2 1/2 In. Diam. 7 No.
Soil Samples --- In. Diam. --- No.

Hammer Wt. 140 lb Boring Started 9/9/93
Hammer Drop 30 in Boring Completed 9/9/93
Casing Left ---
Subsurface Water Date --- Page ---
Obs. Well ---
Drilled By PAUL DAVIS, ROB PRICE
Mfg. Des. Drill CMG 45 TRUCK MOUNT
Inspected By T. ELDRIDGE
Classification By T. ELDRIDGE
Classification By ---

DEPTH	CORE/SAMPLE			BLOWS PER FT	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	NO.	SIZE	DEPTH RANGE			
-2-2 -	0	S-1	0.0	5	140 lb. HAMMER 30 IN DROP NW ROD 2 1/2" SPLIT SPOON	S-1: Olive gray, M. SAND, a few shell fragments (SP).
-3-2	1		TO	6		
			2-0	7	SPUN & WASHED CASING TO -4.2' NGVD EASY DRILLING 3RD GEAR - 1/2" 3/4" throttle	
-4-2	2	S-2	2.0	23	140 lb HAMMER 30 IN DROP NW ROD 2 1/2" SPLIT SPOON	S-2: Olive gray, M.-C. SAND, abun. shell frags. (SP).
			TO	18		
-5-2	3		4.0	15	SPUN & WASHED CASING TO -6.2' NGVD	
				25		
-6-2	4	S-3	4.0	22	140 lb HAMMER 30 IN DROP NW ROD 2 1/2" SPLIT SPOON	S-3: Same as S-2, but fewer shell frags.
			TO	11		
-7-2	5		6.0	10	SPUN & WASHED CASING TO -8.2' NGVD	
				14		
-8-2	6	S-4	6.0	4	140 lb. HAMMER 30 IN DROP NW ROD 2 1/2" SPLIT SPOON	S-4: Olive gray, C. SAND, a few shell frags (SP)
			TO	4		
-9-2	7		8.0	3	SPUN & WASHED CASING TO -10.2' NGVD 3RD GEAR - 1/2" throttle	
				4		
-10-2	8	S-5A	8.0	2	140 lb. HAMMER 30 IN DROP NW ROD 2 1/2" SPLIT SPOON	S-5A: Same as S-4.
			TO	3		
-11-2	9		10.0	9	SPUN & WASHED CASING TO -12.2' NGVD	9.0' estimated (12" rec., 6" ea.)
				17		S-5B: Dk. olive gray, M.-C. SAND, some gravel pieces (S-15), little silt (O-10) (SP)
-12-2 -	10	S-5B				

GENERAL REMARKS:
NGVD = NATIONAL GEODETIC VERTICAL DATUM

DEPTH		CORE/SAMPLE		BLOW PER FT CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	ft.	NO.	SIZE			
-12.2	10	5-6	10.0 to 11.3	41 70 50/3	140 lb HAMMER 30 IN DROP NW ROD 2 1/2" SPLIT SPOON BORING REFUSAL @ 13.5' NGVD	S-6: Olive gray F.-c. GRAVEL, some m.-c. sand (10-20) (GP).
-13.2	11					Refusal @ 11.3'
-14.2	12					

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

Site WINNAPANG POND Page 1 of 2 Pages

Boring No. FD93-6 Desig. FD93-G Diam. (Casing) 4" HW

FIELD LOG OF TEST BORING

Co-ordinates: N 88387.5 E 415639.0

Elevation Top of Boring -2.0' NGVD Hammer Wt. 140 lb Boring Started 9/9/93
Total Overburden Drilled 7.3' Feet Hammer Drop 30 IN Boring Completed 9/9/93
Elevation Top of Rock — M.S.L. Casing Left —
Total Rock Drilled — Feet Subsurface Water Data — Page —
Elevation Bottom of Boring -9.3 NGVD Obs. Well —
Total Depth of Boring 7.3 Feet Drilled By PAUL DAVIS, ROB PRICE
Core Recovered — % No. Boxes — Mfg. Des. Drill CME 45 ~~FEED~~ SKID RIG
Core Recovered — Ft : — Diam. — In. Inspected By T ELDRIDGE
Soil Samples 2 1/2 In. Diam. 7 No. Classification By T ELDRIDGE
Soil Samples — In. Diam. — No. Classification By —

DEPTH	CORE/SAMPLE			BLOWS PER FT	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	NO.	SIZE	DEPTH RANGE			
-2.0	0	S-1A	0.0	4	140 lb. HAMMER 30 IN DROP NW ROD 2 1/2" SPLIT SPOON	S-1A: Olive gray F.-M. SAND, little organic silt (S-15) (SP).
-3.0	1		To	6		
		S-1B	2.0	6	SPOW WASHED CASING TO -4.0' NGVD EASY DRILLING	
-4.0	2			4		
		S-2	2.0	3	140 lb. HAMMER 30 IN DROP NW ROD 2 1/2" SPLIT SPOON	S-2: Gray, F.-M. SAND (w/ brown Fe stained spots) (SP).
-5.0	3		To	1		
			4.0	1	SPOW WASHED CASING TO -6.0' NGVD	No Recovery
-6.0	4	S-3A	4.0	13	140 lb. HAMMER 30 IN DROP NW ROD 2 1/2" SPLIT SPOON	S-3A: Olive gray, M.-C. SAND, some shell frags, orgs. (SP).
-7.0	5	S-3B	To	21		
			6.0	40	SPOW WASHED CASING TO -8.0' NGVD RELATIVELY EASY DRILLING	S-3B: Olive F. SAND, some f.-m. gravel (20-30), tr. - little silt (0-10) (SM/ST)
-8.0	6	S-3C	6.0	42		
		S-4	6.0	28	140 lb. HAMMER 30 IN DROP NW ROD 2 1/2" SPLIT SPOON	S-3C: Gray F.-M. GRAVEL, little c. sand (S-15), (GP)
-9.0	7		To	40		
			7.3	50/3	BORING REFUSAL - 9.3' NGVD	S-4: Gray and vari-colored F.-C. GRAVEL (granite, gneiss little c. sand (0-10), (GP)
-10.0	8					
-11.0	9					
-12.0	10					Refusal

GENERAL REMARKS:

NGVD = NATIONAL GEODETIC VERTICAL DATUM

2 1/2" SPLIT SPOON REFERS TO 2 1/2" INSIDE DIAMETER OF
SAMPLER

U. S. ARMY
CORPS OF ENGINEERS
NEW ENGLAND DIVISION

Site WINNAPAG POND Page 1 of 1 pages

Boring No. FD93-7 Desig. FD93-H Diam. (Casing) 4" MW

FIELD LOG OF TEST BORING

Co-ordinates: N 89078-6 E 416457.2

Elevation Top of Boring -4.4 ^{NGVD} Hammer Wt. 140 lb. Boring Started 9/9/93
Total Overburden Drilled 5.8 Feet Hammer Drop 30 in
Elevation Top of Rock - M.S.L. Casing Left - Boring Completed 9/9/93
Total Rock Drilled - Feet Subsurface Water Data - Page -
Elevation Bottom of Boring -10.2 ^{NGVD} Obs. Well -
Total Depth of Boring 5.8 Feet Drilled By PAUL DAVIS, ROB PRICE
Core Recovered - % No. Boxes - Mfg. Des. Drill CME 45 SKID RIG
Core Recovered - Ft : - Diam. - In. Inspected By T ELDRI06E
Soil Samples 2 1/2 In. Diam. 3 No. Classification By T ELDRI06E
Soil Samples - In. Diam. - No. Classification By -

DEPTH ft	CORE/SAMPLE		BLOWS PER FT CORE RECVY	SAMPLING AND CORING OPERATIONS	CLASSIFICATION OF MATERIALS
	NO.	SIZE			
-4.4	0	S-1	0.0	140 lb. HAMMER 30 IN DROP NW ROD 2 1/2" SPLIT SPOON	S-1: Dk. olive gray, organic SILT, tr. f. sand (OM)
-5.4	1		10		
-6.4	2		2.0	SPUN & WASHED CASING TO -6.4' NGVD EASY DRILLING	
-7.4	3		2.0	140 lb. HAMMER 30 IN DROP NW ROD 2 1/2" SPLIT SPOON	S-2: Olive gray, organic silty (10-20), F. SAND, trace f.-m. gravel. (SP/SM).
-8.4	4	S-2	4.0	SPUN & WASHED CASING TO -8.4' NGVD	
-9.4	5	S-3	4.0	140 lb HAMMER 30 IN DROP NW ROD 2 1/2" SPLIT SPOON	S-3: Olive gray and varicolored F.-C. GRAVEL, little f.-c. sand (10-20) (GP).
-10.4	6		5.8	BORING REFUSAL @ -10.2' NGVD	S. 8'
-11.4	7		20 1/2		
-12.4	8				
-13.4	9				
-14.4	10				

GENERAL REMARKS:

NGVD = NATIONAL GEODETIC VERTICAL DATUM

2 1/2" SPLIT SPOON REFERS TO 2 1/2" INSIDE DIAMETER
OF SAMPLER

MISQUAMICUT BEACH, WESTERLY, RI

ATTACHMENT D

GRADATION OF SAMPLES FROM WINNAPAUG POND

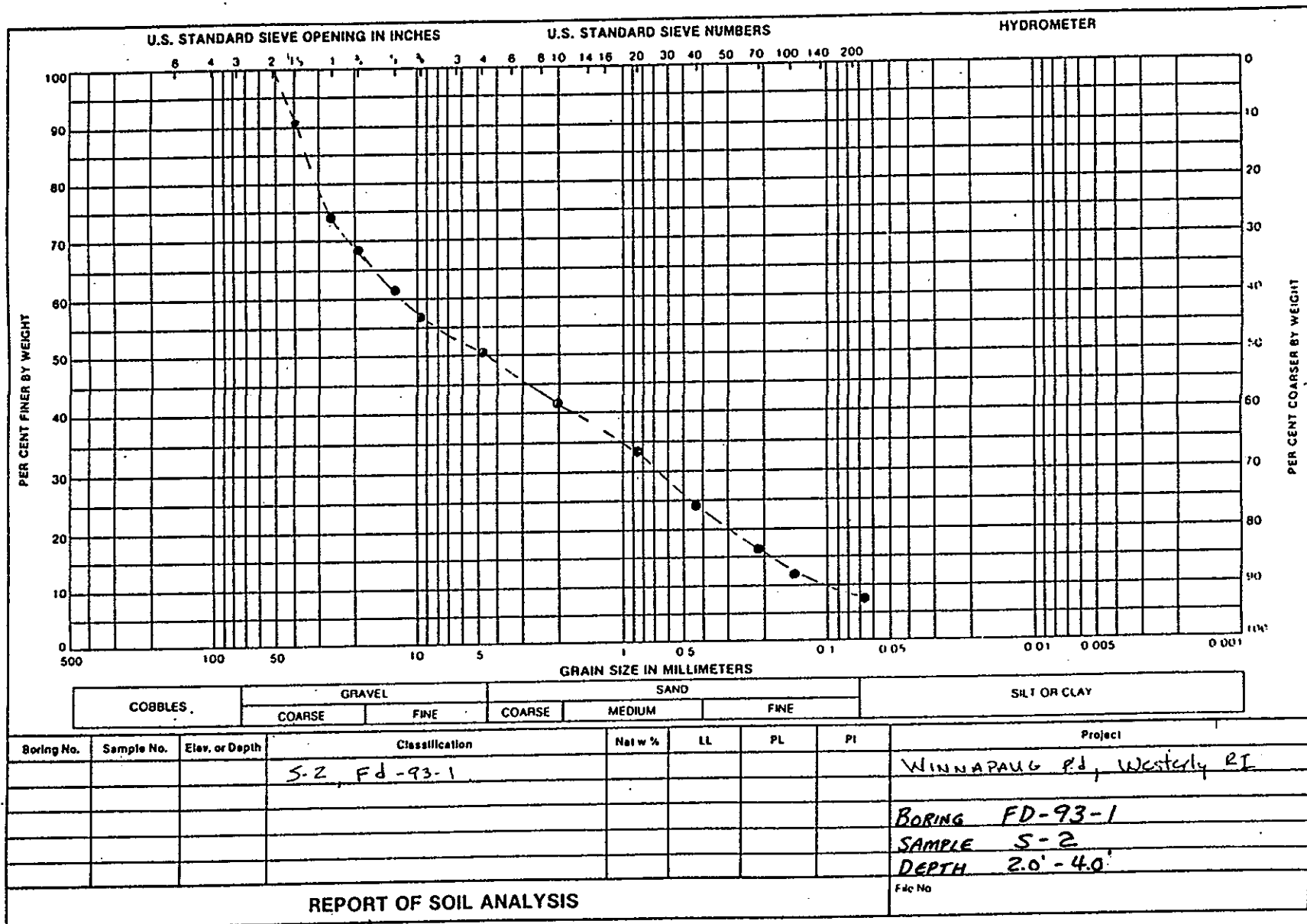
Department of the Army
 Report No. 446-30399-1
 October 25, 1993
 Page 2

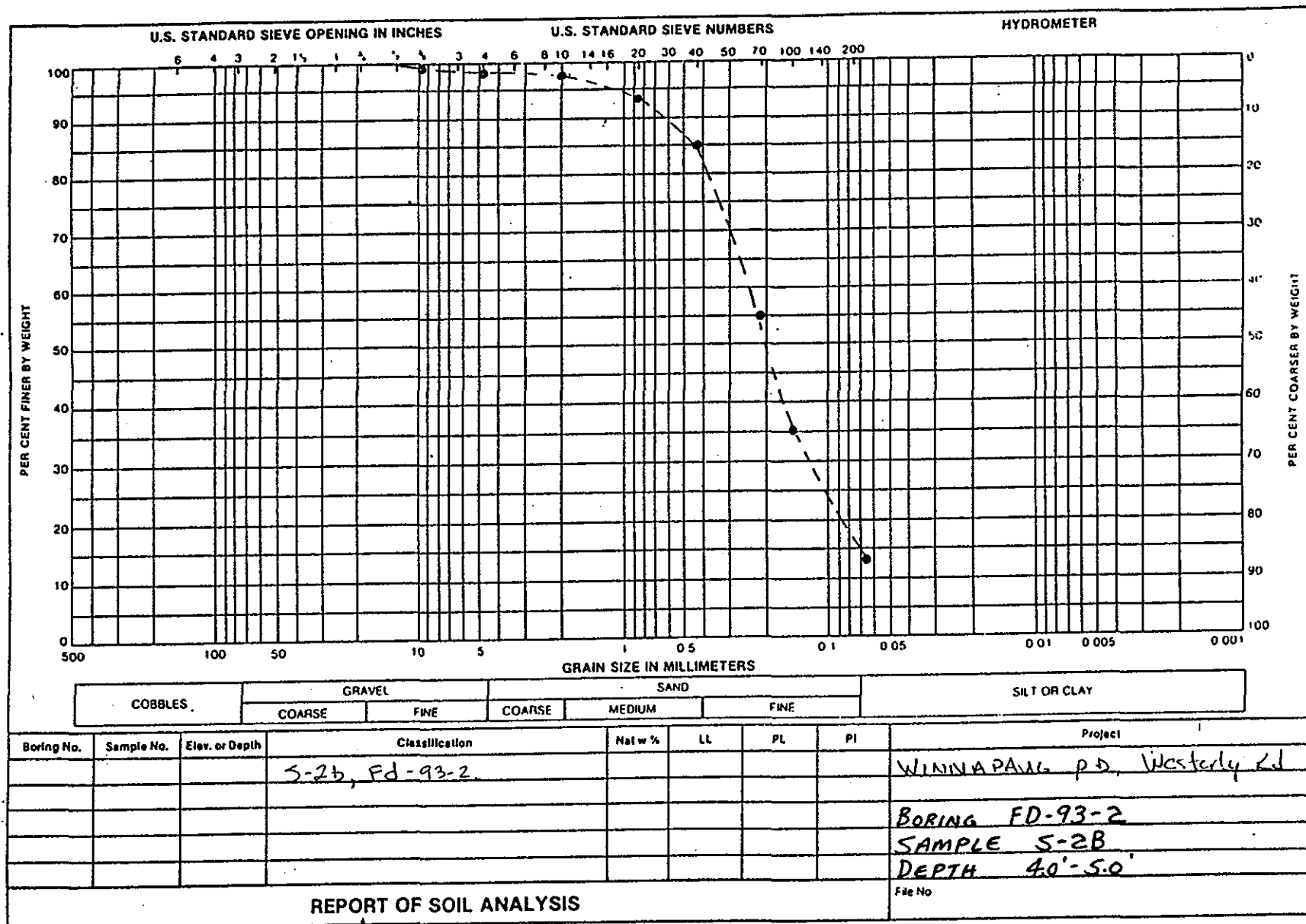
1. Sample Description

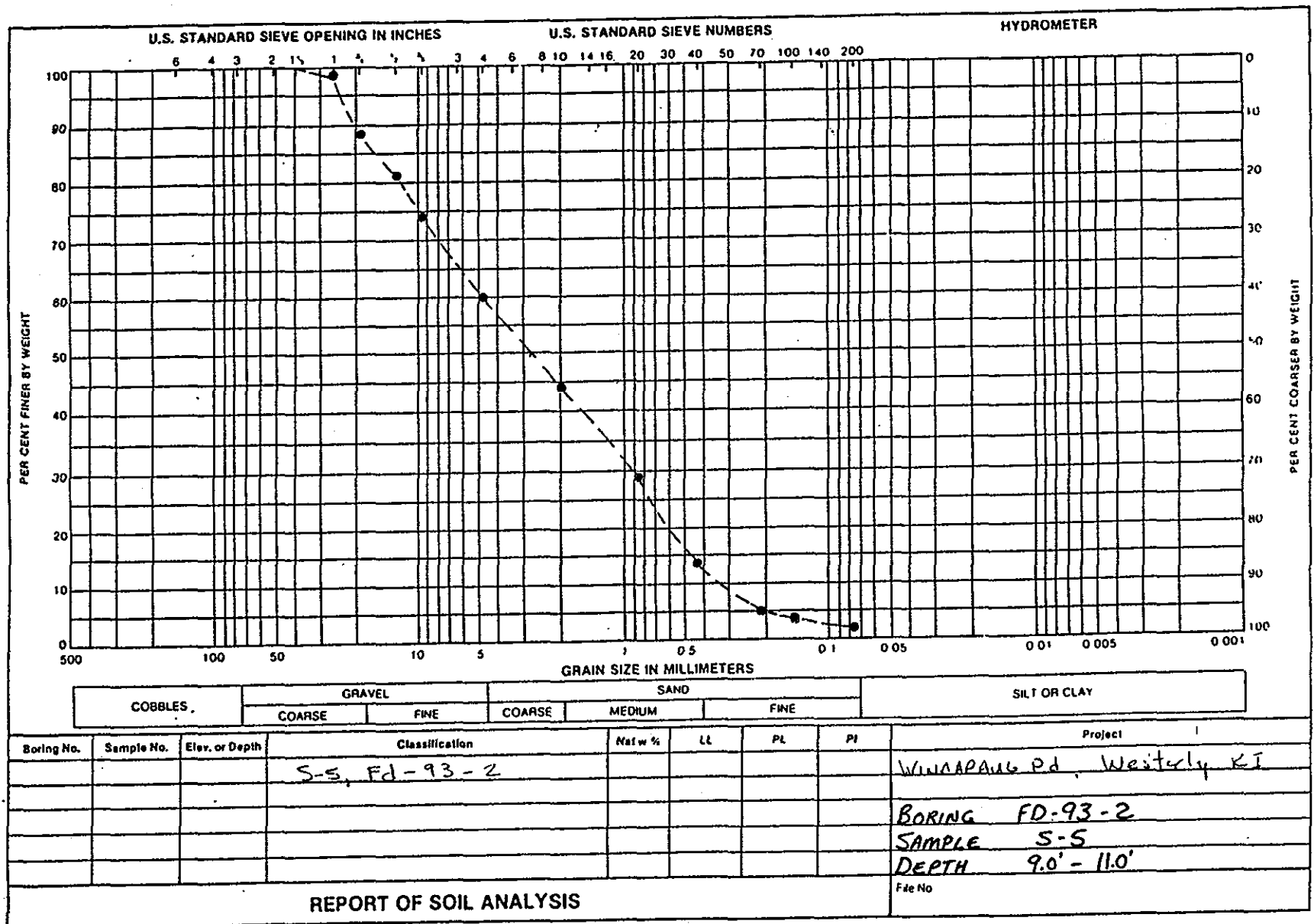
<u>Sample No.</u>	<u>Description</u>	<u>Classification</u>	<u>Source</u>
C-732a	Gravel w/Silt & Sand	GP.GM	S-2,Fd-93-1
C-732b	Silty Sand	SM	S-2B,Fd-93-2
C-732c	Sandy w/Gravel	SP	S-5,Fd-93-2
C-732d	Sand	SP	S-3,Fd-93-4
C-732e	Sand(some organic shells)	SP	S-2,Fd-93-5
C-732f	Sand(some organic shells)	SP	S-4,Fd-93-5

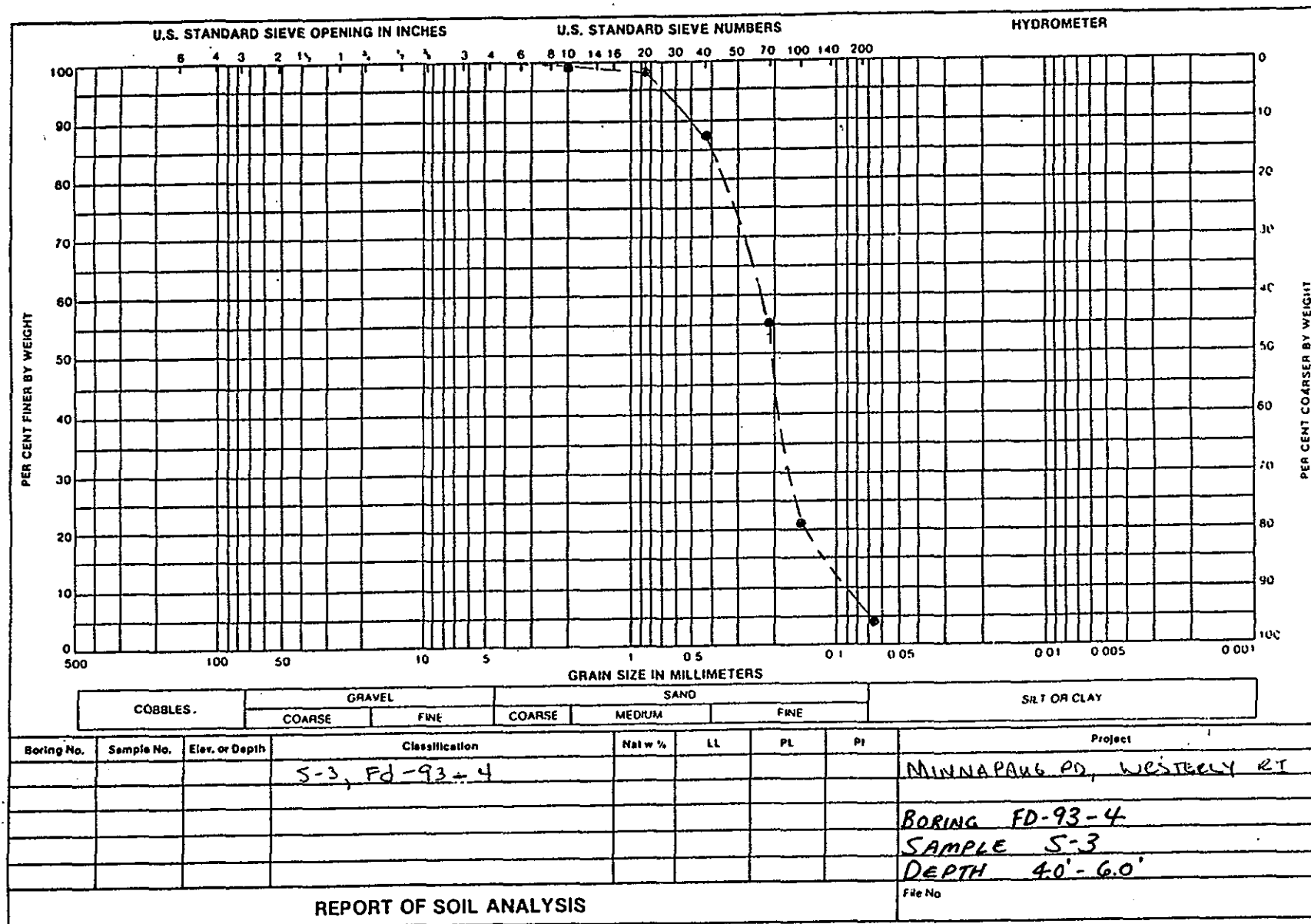
2. Washed Sieve Analysis (% passing by weight)

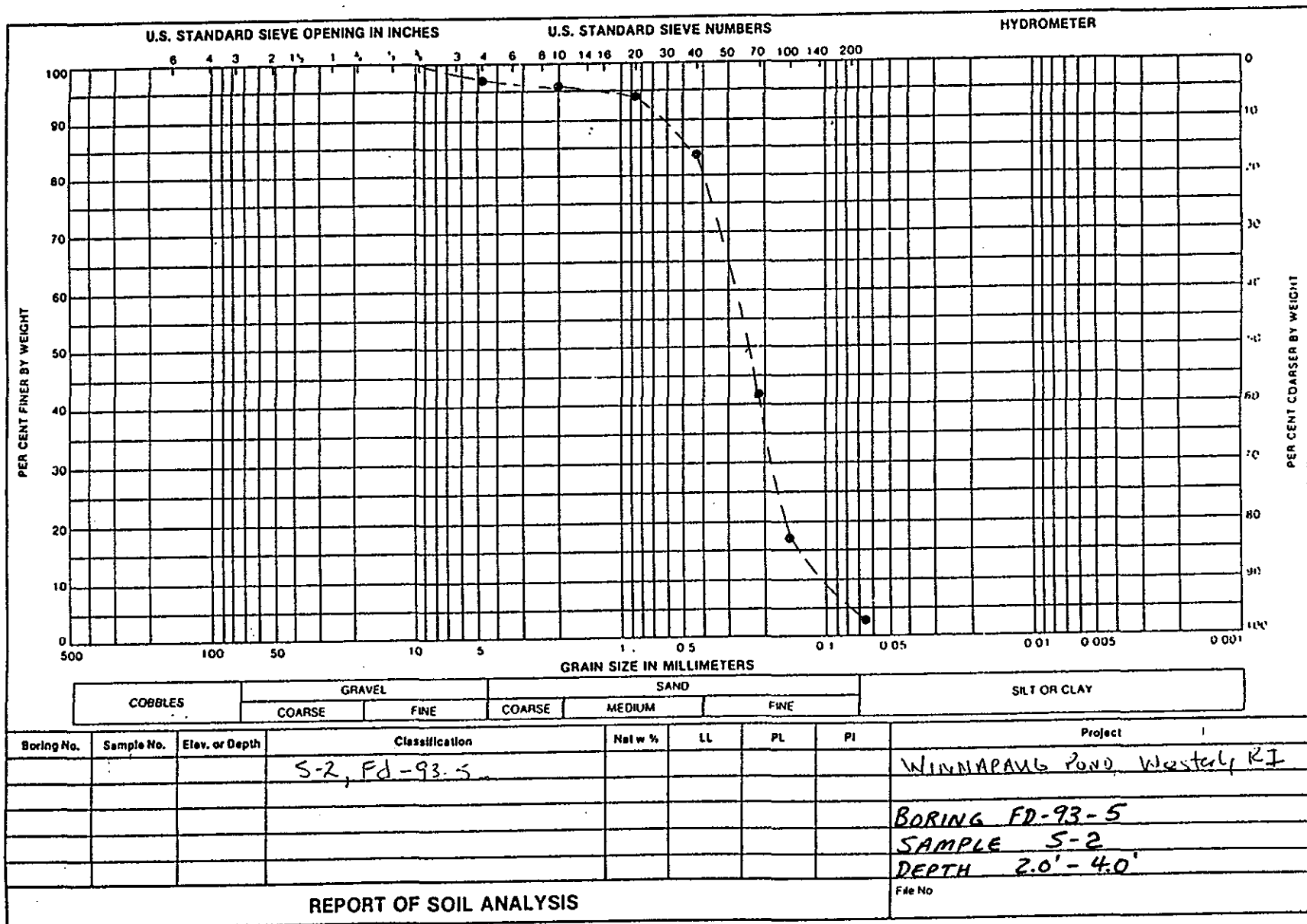
<u>Sieve Size</u>	<u>C-732a</u>	<u>C-732b</u>	<u>C-732c</u>	<u>C-732d</u>	<u>C-732e</u>	<u>C-732f</u>
2"	100					
1 1/2	91		100			
1	74		97			
3/4	68		88			
1/2	61	100	81			
3/8	57	99	74		100	100
#4	50	98	60	100	97	98
10	42	97	44	99	96	94
20	33	93	28	98	94	67
40	24	85	13	87	83	24
70	16	55	5	55	42	8
100	12	35	4	21	17	4
200	6.7	13.1	2.2	3.8	2.7	1.4

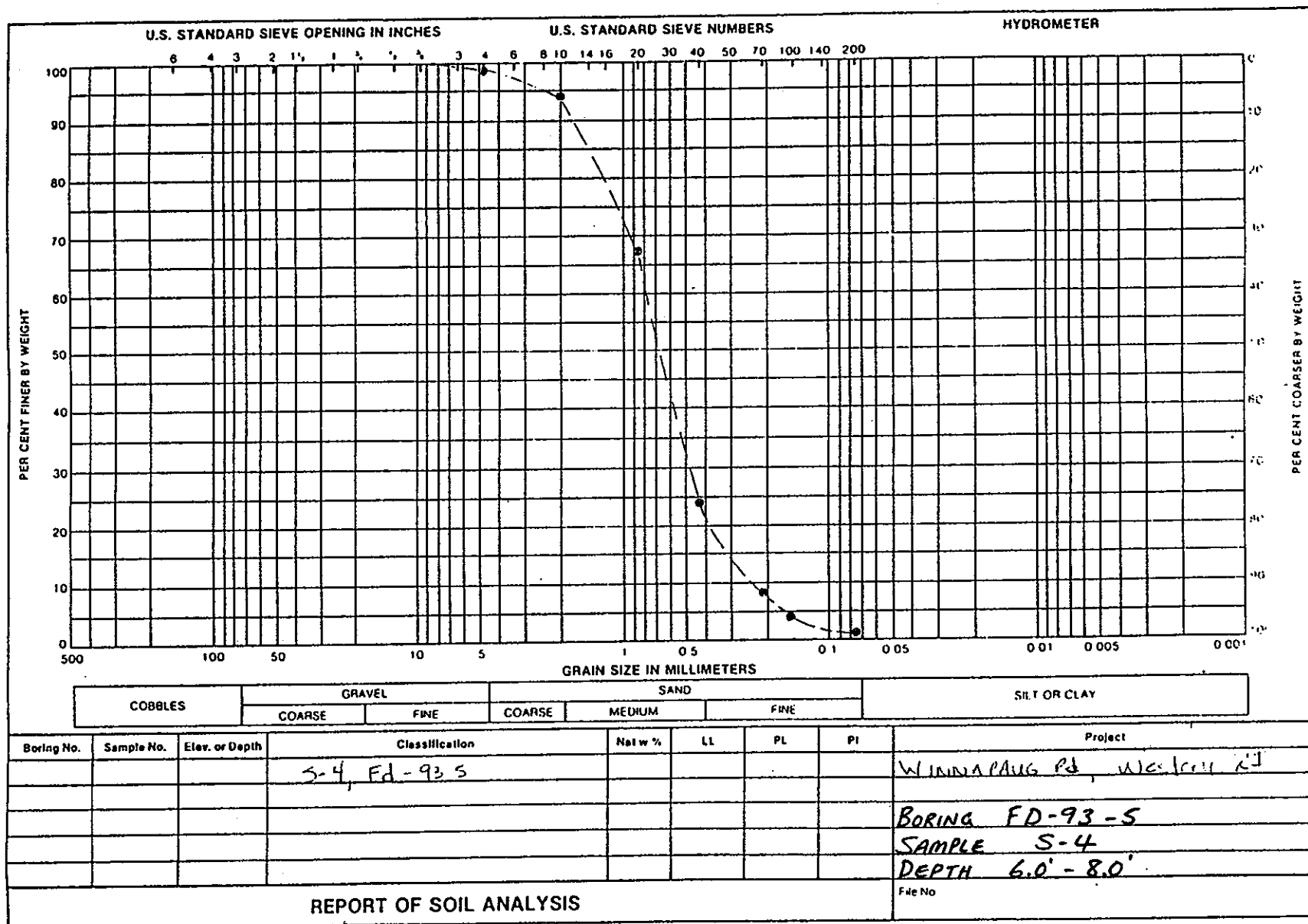












APPENDIX E
PERTINENT CORRESPONDENCE



Town of Westerly
Rhode Island

December 22, 1992

Office of the Town Manager

Colonel Brink Miller
Army Corp. of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02254

Dear Sir:

I am writing to you today to request, on behalf of the Town of Westerly, evaluation of the Misquamicut beach area which has suffered significant erosion over the last few years. The condition of the dunes on our barrier beach at this point is critical and cannot be expected to re-generate itself in the near future.

There is also significant problem with sedimentation in Winnapaug Pond which over the last 20 years has filled in to the point that under normal high tide conditions portions of Atlantic Avenue which runs between the barrier beach and Winnapaug Pond chronically overflow. Under storm conditions, this 3 miles of road is virtually impassable due mainly to the pond's inability to absorb a minimum amount of coastal storm surge.

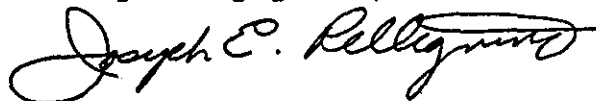
The condition of our shoreline has been evaluated by both Coastal Resources Management Council and also the Rhode Island Emergency Management Agency. This past storm (Beth) on December 11, 12, and 13, 1992 left the Town of Westerly beaches in such a condition, that if another storm of any significance were to hit this area, major structural damage to properties along this 3-mile beach would be inevitable.

I have asked the Director of Coastal Resources Management Council and the Rhode Island Emergency Management Agency to also provide their evaluation of the impacts of the recent storm on our beach in an effort to substantially support our request for assistance to evaluate this most critical situation.

I will be forwarding to you in the coming week, additional photographic and other detailed information to assist the Army Corp. in review of our request.

Thank you for your assistance in this matter and look forward to meeting with you in the not too distant future.

Very truly yours,



Joseph E. Pellegrino
Town Manager

JEP/ds

xc: Honorable Members, Westerly Town Council
Hon. John F. Reed, US Representative
Hon. Claiborne Pell, US Senator
Hon. John H. Chafee, US Senator
Joseph Carnevale, Jr., Emergency Management Agency
Grover J. Fugate, Coastal Resources Management Council



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

REPLY TO
ATTENTION OF

December 23, 1992

Operations Directorate
Project Operations and
Readiness Division

Honorable Jack Reed
House of Representatives
Washington, DC 20515-3902

Dear Mr. Reed:

I am writing in response to our telephone conversation of December 14, 1992 and your follow up letter of the same date concerning the coastal damages sustained in Westerly, Rhode Island.

On December 15th a member of my staff met with Mr. Joseph Peligrino, the Town Manager for Westerly, and assessed the damages sustained to the Town's coastal areas as a result of the December 11-12 coastal storm. Mr. Peligrino was informed that we do have a number of programs that enable us to determine the Federal interest in constructing beach erosion and coastal protective structures and that some of the impacted areas may warrant further investigation. While these authorities require a public sponsor and usually address effecting repairs and/or improvements to publicly owned property, we indicated to him that we would be willing to assess the entire area and then determine which areas and features of the coastline would be eligible for Corps of Engineers assistance. We have provided Mr. Peligrino with the necessary information he will need to formally request our involvement and it is my understanding that such a request will soon be forthcoming.

With respect to the emergency authorities of the Corps of Engineers, Public Law 84-99, grants us the authority to perform emergency relief efforts during or following a flood or coastal storm. Assistance to individual homeowners or businesses is not permitted. We are able to repair/restore only those shore protection projects which were congressionally authorized and Corps constructed. While our emergency authorities are such that we could, at the request of a governor, temporarily shore up a weak point in a coastal protective system during or immediately preceding a predicted storm we do not have the authority to effect permanent repairs. Once the immediate threat to loss of life or damage to property has passed, our ability to operate and

conduct emergency operations within a state is severely curtailed. During the storm in question our emergency operations center was in constant contact and communication with the Rhode Island Emergency Management Agency informing them of our authorities and the necessary procedures to obtain our assistance should it be required. We did not receive any requests for assistance with the exception of providing 20,000 sandbags for use in Westerly. We also delivered an additional 50,000 sandbags to Quonset Point to be used as an emergency reserve should additional coastal flooding become a possibility during the next few months.

Should you have any questions or require further information please do not hesitate to contact me at (617) 647-8220 or your staff may contact Mr. Steven Andon at (617) 647-8272.

Sincerely,

Brink P. Miller
Colonel, Corps of Engineers
Division Engineer

Copy furnished:

Honorable Jack Reed
Representative in Congress
355 Centerville Road
Building 3
Warwick, Rhode Island 02886

CF Planning Dir.

Smith
Prenovest

JACK REED
2ND DISTRICT, RHODE ISLAND

COMMITTEES
EDUCATION AND LABOR
JUDICIARY
MERCHANT MARINE AND FISHERIES

Congress of the United States
House of Representatives
Washington, DC 20515-3902

PLEASE RESPOND TO:

WASHINGTON:
☐ 1229 LONGWORTH BUILDING
WASHINGTON, DC 20515-3902
(202) 225-2735
DISTRICT:
☐ 355 CENTERVILLE ROAD
BUILDING 3
WARWICK, RI 02886
(401) 737-2900

March 4, 1993

Colonel Brink P. Miller
Colonel
Army Corps of Engineers
Division Engineer
424 Trapew Road
Waltham, Massachusetts 02254

JFR Dear Colonel Miller:

I am writing to you on behalf of State Senator, Dennis Algiere. Mr. Algiere has contacted my office to inquire about dredging a local salt pond in Westerly, R.I.

Enclosed please find a copy of Mr. Algiere's letter. I would greatly appreciate any information you may be able to provide as to the feasibility of dredging Winnapaug Pond. Mr. Algiere has stated that the pond is currently in poor condition.

Should you require additional information from me or my staff relative to this correspondence, please do not hesitate to contact Christine Grinnell of my staff directly at 401-943-3100 or Garden City Center, 100 Midway Place, Suite #5, Cranston, RI, 02920.

Thank you in advance for your attention and assistance in this matter, and we look forward to hearing from you.

Warmest Regards.

Sincerely,

Jack Reed
Jack Reed
Member of Congress

JFR/cmg

State of Rhode Island and Providence Plantations

SENATOR
DENNIS L. ALGIERE
10 Penston Avenue
Westerly, Rhode Island 02891

Room 21, State House
Providence, Rhode Island 02903

Res.: 401-596-2215
Bus.: 401-277-2708
Fax: 401-277-1206



Senate Chamber

Committee on Judiciary
Committee on Special Legislation

March 1, 1993

Raymond D. Simone, Chief of Staff
Honorable John F. Reed's Office
100 Midway Place, Garden City
Cranston, RI 02920

Dear Mr. Simone:

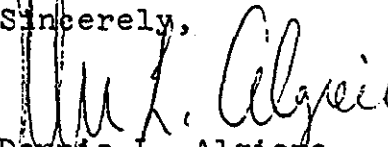
It was a pleasure speaking with you last week at the
Westerly Town Hall.

Certainly your staff and Congressman Reed are no strangers
to Westerly. We appreciate the amount of time you spend in our
town. The people do see it.

Could your office look into the possibility of the Army Corp
of Engineers dredging Winnapaug Pond? Winnapaug Pond is one of
several salt ponds in the area and is at a stage where it is
critical that something be done.

I look forward to hearing from you.

Sincerely,


Dennis L. Algieri
SENATOR, District 26

DLA:clr



Town of Westerly
Rhode Island

March 17, 1993

Office of the Town Manager

Mr. John Smith
Army Corps. of Engineers
New England Division
424 Trapelo Road
Waltham, MA 02254

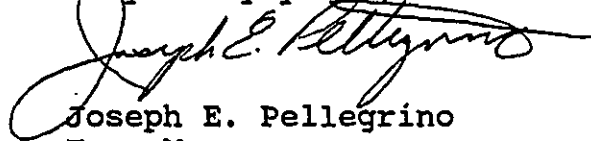
Dear Mr. Smith:

I would like to take this opportunity to thank you for taking the time to come to Westerly to participate in our meeting with local and state officials regarding the chronic erosion and flooding problems in the Misquamicut beach area.

I found the previous project description that you provided me with to be very informative. We will begin the process of documenting our needs in this area and will be contacting you in the near future. Also, please thank Mr. O'Leary for his input on economic requirements for a project of this scope.

I look forward to working with you in the future on this project.

Very truly yours,


Joseph E. Pellegrino
Town Manager

JEP/ds

March 19, 1993

Planning Directorate
Plan Formulation Division

Honorable John F. Reed
House of Representatives
Washington, DC 20515-3902

Dear Mr. Reed:

I am writing in response to your letter of March 4, 1993 regarding the dredging of Winnapaug Pond in Westerly, Rhode Island.

Messrs. John T. Smith and Edmund O'Leary of my staff participated in a public meeting, concerning the effects of recent storms on the beach, in Westerly on March 16. You will note from the attached attendance list that Ms. Nancy Lonzall and Mr. Tim Dolan of your staff, as well as, Rhode Island State Senator Dennis Algiere attended the meeting. The meeting dealt with the coastal flood problem and associated erosion and siltation.

I understand that recent storms have eroded much of the three mile long beach and in certain areas the dune line has been breached. There has been considerable damage to homes, businesses and roadways. Sand from the beach has washed into the backshore tidal ponds. We at the Corps are presently assessing the damages and potential corrective measures. If it appears likely that there is an opportunity for Corps assistance, we will proceed with a reconnaissance study. The reconnaissance study will be completed within a year.

Corps of Engineers authorities will not allow us to dredge ponds for water quality or aesthetic purposes, however, the problem at Winnapaug Pond may be considered part of the overall coastal flooding problem. We can assist in storm damage reduction if certain criteria are met. The ongoing study will determine if those economic, sponsorship, environmental acceptability criteria are met. Reestablishing a beach, perhaps dunes with or without groins based on our preliminary review is a likely alternative to solve the problems. If such a solution were to be pursued by the Corps or anyone else, a source of sand would be sought. One consideration would certainly be the backshore salt ponds. In this way, perhaps solving the problem (siltation) in the salt ponds would be accomplished while reducing the damage caused by coastal flooding.

I trust this answers your question. We will keep you informed as our work progresses. If you require further information, I can be reached on (617) 647-8220, or you may contact Mr. John T. Smith who will conduct the study at (617) 647-8528.

Sincerely

Brink P. Miller
Corps of Engineers
Division Engineer

Attachment

Copy Furnished:

Honorable John F. Reed
Representative in Congress
355 Centerville Road
Warwick, Rhode Island 02886

CECWZ-E

cc:

Mr. Smith
Mr. Pronovost
Plng Dir Files/114N
Reading Files
CECWZ-E
CDB Files/114S

WESTERLY, RHODE ISLAND
MEETING OF MARCH 16, 1993

TOWN HALL

ATTENDANCE LIST

MARY JANE DI MART, COUNCILOR
JOHN HILL, PROVIDENCE J-B
RITA LORD, PROVIDENCE JOURNAL
ALAN GOLELIN, CRMC
BARRY F. COLE, WESTERLY TC
TIM DOLAN, CONGRESSMAN REED'S OFFICE
NANCY L. LONZALL, CONGRESSMAN REED'S OFFICE
TERRY T. WALSH, RI DEM - WATER RESOURCES
JEFF WILLIS, CRMC
DONNA LYNNE DOYLE, CRMC
JOHN SPOSATO
TOM MEDEIROT, CRMC
PHILIP KORETSK, MISQUIMICUT CLUB
NANCY HESS
CHARLES VACCA
PAT PERRI
DENNIS L. ALGIERE, RI SENATOR
MARIO P. CELICO, PRES. MISQ. BUSINESS ASSOC.
NICOLA BELLORE, BREEZEWAY MOTEL
JOHN BELLORE, BREEZEWAY MOTEL
PETER BELLORE, MBA V.P., BREEZEWAY MOTEL
EDMUND O'LEARY, U.S. ARMY, CORPS OF ENGINEERS
JOHN T. SMITH, U.S. ARMY, CORPS OF ENGINEERS
RAY CHERENZIK, CHEREYI & ASSOC.
LUIS J. WITT
WILLIAM G. SCOLA, 25 ATLANTIC AVE.
JOSEPH CARNEVALI, DIR RI EMA
RAY JA BELLE, SPEC. PROJECTS - RI EMA
NEFTALI SOTO, TOWN ENGINEER, TOWN OF WESTERLY
GLENN W. HEDMAN, ASST. TOWN ENGINEER, TOWN OF WESTERLY

Langrall

April 9, 1993

Planning Directorate
Coastal Development Branch

Honorable John F. Reed
House of Representatives
Washington, DC 20515-3902

Dear Mr. Reed:

I am writing as a furtherance of my March 19, 1993 letter and my discussion of April 7, 1993 with Mr. J. B. Poersch of your staff regarding Corps of Engineers activities at Misquamicut Beach in Westerly.

The town, by letter on December 22, 1992, requested assistance with a shoreline erosion problem that has been worsened by several recent storms. More recently, the northeaster of March 1993 also caused considerable damage. On March 16th Mr. John T. Smith of my staff met with and toured the beach with the Town Manager, Ms. Nancy L. Langrall, and Mr. Tim Dolan of your staff, Rhode Island Senator Dennis L. Algiere and others. The attendance list of that meeting is attached. Mr. Smith explained how the Corps might be able to help.

The damage suffered thus far is significant in both intensity and areal extent. Based on what Mr. Smith saw, this office made a preliminary assessment of benefits that might be achieved if the entire beach were to be afforded protection. The estimated \$2.6 million benefit figure on an average annual basis is certainly sufficient to support our decision to proceed with a reconnaissance study. This will be accomplished over the next year with Federal funds that are available under our Continuing Authorities Program. The reconnaissance study will accomplish three things. We will determine if there is a likelihood of formulating a project that can be economically justified and otherwise meets the criteria for Corps assistance. The study will identify a non-Federal public sponsor to share the cost of the next stage of work, a feasibility study and subsequently share in the cost of construction. Finally, the study will determine the environmental and social acceptability of likely corrective measures.

The Continuing Authorities Program allows problems to be studied and construction funded at the Assistant Secretary of the Army level and requires no Congressional action. It is a time efficient program with only one possible drawback to the problem at hand, a \$5 million Federal spending cap. If the reconnaissance study indicates that a significantly larger project is in the offing, separate Congressional funding would be needed to conduct the necessary studies, design and construction.

You should be aware that a 3 mile long shore protection project for this area was Congressionally authorized in 1965, and subsequently deauthorized by the 1986 Water Resources Act. The project consisted of a stone revetment, sand beach fill and groins. The sand was to be taken from a backshore tidal pond thereby creating a channel and anchorage for small boats. Lack of local support i.e. providing the \$1,425,000 local share of the \$4,750,000 total cost was the reason the project was never implemented. There are many features in the 1965 project that may no longer meet Federal and State criteria. For example: excavation in the backshore tidal pond, the construction of a stone revetment in the dune area, and the construction of 31 stone groins. This is not to say that we cannot formulate an acceptable plan, but any plan that we do develop will probably rely less on structural measures than did the 1965 plan.

Mr. John Grzebien of Senator John H. Chafee's office has asked that we meet at Westerly with him, Rhode Island Senator Algieri and perhaps a representative from U.S. Representative Ronald K. Machtley's office tentatively on April 14 at 11:00 am. Mr. Smith will attend that meeting.

I trust this information will meet your present needs. If you wish further discussion, please do not hesitate to call me at (617) 647-8220 or Mr. Smith of my staff at (617) 647-8528.

Sincerely,

Brink P. Miller
Colonel, Corps of Engineers
Division Engineer

Attachment

Copy Furnished:

Honorable John H. Chafee
Representative in Congress
301 Pastore Building
Providence, Rhode Island 02903

CECWZ-E

cc:

Mr. Smith
Mr. Pronovost
Plng Dir Files
Reading Files
CDB Files/114N

WESTERLY, RHODE ISLAND
MEETING OF MARCH 16, 1993

TOWN HALL

ATTENDANCE LIST

MARY JANE DI MART, COUNCILOR
JOHN HILL, PROVIDENCE J-B
RITA LORD, PROVIDENCE JOURNAL
ALAN GOLELIN, CRMC
BARRY F. COLE, WESTERLY TC
TIM DOLAN, CONGRESSMAN REED'S OFFICE
NANCY L. LANGRALL, CONGRESSMAN REED'S OFFICE
TERRY T. WALSH, RI DEM - WATER RESOURCES
JEFF WILLIS, CRMC
DONNA LYNNE DOYLE, CRMC
JOHN SPOSATO
TOM MEDEIROT, CRMC
PHILIP KORETSK, MISQUIMICUT CLUB
NANCY HESS
CHARLES VACCA
PAT PERRI
DENNIS L. ALGIERE, RI SENATOR
MARIO P. CELICO, PRES. MISQ. BUSINESS ASSOC.
NICOLA BELLORE, BREEZEWAY MOTEL
JOHN BELLORE, BREEZEWAY MOTEL
PETER BELLORE, MBA V.P., BREEZEWAY MOTEL
EDMUND O'LEARY, U.S. ARMY, CORPS OF ENGINEERS
JOHN T. SMITH, U.S. ARMY, CORPS OF ENGINEERS
RAY CHERENZIK, CHEREYI & ASSOC.
LUIS J. WITT
WILLIAM G. SCOLA, 25 ATLANTIC AVE.
JOSEPH CARNEVALI, DIR RI EMA
RAY JA BELLE, SPEC. PROJECTS - RI EMA
NEFTALI SOTO, TOWN ENGINEER, TOWN OF WESTERLY
GLENN W. HELMAN, ASST. TOWN ENGINEER, TOWN OF WESTERLY

April 26, 1993

Planning Directorate
Plan Formulation Division

Honorable Ronald K. Machtley
House of Representatives
Washington, DC 20515-3901

Dear Mr. Machtley:

I am writing as a furtherance of my April 14 telephone discussion with you and your letter of April 13. You seek Corps of Engineers assistance in solving a coastal erosion problem at Misquamicut Beach in Westerly.

The town, by letter on December 22, 1992, requested assistance with a shoreline erosion problem that has been worsened by several recent storms. Most recently, the northeaster of March 1993 also caused considerable damage. On March 16, and again on April 14, Mr. John T. Smith of my staff met with and toured the beach with the Town Manager, State officials, representatives of Senators Chafee and Pell and Congressman Reed, Rhode Island State Senator Algiere and others. The attendance lists of those meetings are attached. Mr. Smith explained how the Corps might be able to help.

The damage suffered thus far is significant in both intensity and areal extent. Based on what Mr. Smith saw, this office made a preliminary assessment of benefits that might be achieved if the entire beach were to be afforded protection. The estimated \$2.6 million benefit figure on an average annual basis is certainly sufficient to support our decision to proceed with a reconnaissance study. This will be accomplished over the next year with Federal funds that are available under our Continuing Authorities Program. The reconnaissance study will accomplish three things. We will determine if there is a likelihood of formulating a project that can be economically justified and otherwise meets the criteria for Corps assistance. The study will identify a non-Federal public sponsor to share the cost of the next stage of work, a feasibility study, and subsequently share in the cost of construction. Finally, the study will determine the environmental and social acceptability of likely corrective measures.

The Continuing Authorities Program allows problems to be studied and construction funded at the Assistant Secretary of the Army level and requires no Congressional action. It is a time efficient program with only one possible drawback to the problem at hand, a \$5 million Federal spending cap. If the reconnaissance study indicates that a significantly larger project is in the offing, separate Congressional funding would be needed to conduct the necessary studies, design, and construction.

-2-

You should be aware that a 3 mile long shore protection project for this area was Congressionally authorized in 1965, and subsequently deauthorized by the 1986 Water Resources Act. The project consisted of a stone revetment, sand beach fill, and groins. The sand was to be taken from a backshore tidal pond thereby creating a channel and anchorage for small boats. Lack of local support i.e. providing the \$1,425,000 local share of the \$4,750,000 total cost was the reason the project was never implemented. There are many features in the 1965 project that may no longer meet Federal and State criteria. For example: excavation in the backshore tidal pond, the construction of a stone revetment in the dune area, and the construction of 31 stone groins. This is not to say that we cannot formulate an acceptable plan, but any plan that we do develop will probably rely less on structural measures than did the 1965 plan.

I do not have the authority to get emergency work underway to make temporary repairs to the beach in time for the 1993 recreation season. The program outline above, if it can be pursued through construction, will take three years at a minimum. We have suggested to the Town that the U.S. Federal Emergency Management Administration (FEMA) is the most likely source of funds for an emergency fix.

I trust this information will meet your present needs, If you wish further discussion, please call me at (617) 647-8220 or Mr. Smith of my staff at (617) 647-8528.

Sincerely,

Brink P. Miller
Colonel, Corps of Engineers
Division Engineer

Attachments

Copy Furnished:

Honorable Ronald K. Machtley
Representative in Congress
200 Main Street, Suite 200
Pawtucket, Rhode Island 02860

CECW-ZE

cc: Mr. Smith
 ~~Mr. Larsen~~
 Mr. Pronovost
 Mr. Andon
 Reading
 CDB Files (disk-EXEC-machtley)

MFR: Coordinated with S. Andon,
Emerg. Ops.

Planning Directorate
Plan Formulation Division

Honorable John H. Chafee
United States Senate
Washington D.C. 20510-3902

Dear Senator Chafee:

I have your letter of July 2, 1993 and its enclosed letter from Ms. Serene Casey O'Connor.

This office has initiated a Reconnaissance study of the shoreline erosion problem of Misquamicut Beach in Westerly. The town requested the study by letter of December 12, 1992. At subsequent meetings, the Town indicated an interest in having Winnapaug Pond dredged and the sand placed in Misquamicut Beach. It is too early in our study to predict whether or not the Corps can assist in this or any other beach improvement at the site.

We reviewed promotional material of the Prefabricated Erosion Prevention (PEP) - Reef in June of 1993. The PEP - Reef was partially put in place at Palm Beach, Florida in August 1992 and the assessments of its success were made 9 months later in May 1993. Hurricane Andrew struck during the placement of the units. According to the promotional material, the PEP - Reef has been very successful. We will continue to review material on this installation as that information becomes available. The PEP - Reef will be among the alternative corrective measures that we consider if the Westerly, Rhode Island study progresses beyond the reconnaissance stage.

We at the New England Division received a request similar to that of Ms. O'Connor last December from a group, the Siasconsett Erosion Committee (SEC) in Nantucket, Massachusetts. Their concern is a 3 mile long beach facing the open ocean. SEC requested information on a product sold under the name Beachsaver, a prefabricated interlocking concrete breakwater. We passed the brochures that SEC enclosed along to the Corps' Coastal Engineering Research Center (CERC) in Vicksburg, Mississippi.

CERC noted that they have not conducted research on the specific technique and they do not maintain any official guidance on the various commercial products available for shoreline stabilization purposes. The New England Division has no experience with precast concrete breakwaters.

Ms. O'Connor is correct in her statement that any organization desiring to put in the type of structures she suggests would require a Corps of Engineers permit. Mr. William Lawless (617) 647-8057 can explain the procedure for securing a Corps permit.

Please don't hesitate to call me on (617) 647-8220 or Mr. John T. Smith, (617) 647-8528, who is overseeing this study, if you require more information.

Sincerely,

Brink P. Miller
Colonel, Corps of Engineers
Division Engineer

Copy Furnished:
Honorable John H. Chafee
United States Senator
301 Pastore Building
Providence, R.I. 02903

cc:
Mr. Pronovost, 114N
Mr. Smith, 114S
XO, 100
Plng. Dir. Files, 114N
Reading Files
CDB Files, 114S

August 12, 1993

Planning Directorate
Impact Analysis Division

Mr. Grover Fugate, Executive Director
Rhode Island Coastal Resources Management Council
Oliver Stedham Government Center
Tower Hill Road
Wakefield, Rhode Island 02879

Dear Mr. Fugate:

The U.S. Army Corps of Engineers is conducting a Section 103 study for Misquamicut Beach in Westerly, Rhode Island. In order to obtain grain size data for this study, boring explorations of Winnapaug Pond are scheduled for the week of August 30, 1993. The drilling program will consist of six borings conducted from a 320 square foot float to a depth of 15 feet below the ground surface. Three days will be required for drilling, and approximately one day each for mobilization and demobilization.

The purpose of this letter is to notify your office of the proposed drilling work. Please inform Ms. Catherine Demos at (617) 647-8231 or Ms. Rose Schmidt at (617) 647-8345 if there are any requirements by your office or others to perform this work. Your immediate response is appreciated.

Sincerely,

Joseph L. Ignazio
Director of Planning

cc: Ms. Demos
Ms. Schmidt
Mr. Larsen ✓
Mr. Hubbard
IAD Files



STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

COASTAL RESOURCES MANAGEMENT COUNCIL

Oliver H. Stedman Government Center
4808 Tower Hill Road
Wakefield, R.I. 02879-1900
(401) 277-2476

Mr. Joseph Ignazio
Department of the Army
New England Division, Corps of Engineers
Planning Directorate
424 Trapelo Road
Waltham, Massachusetts 02254-9149

August 13, 1993

Dear Mr. Ignazio;

The Coastal Resources Management Council appreciates being made aware of the Corps plans to conduct sediment sampling in Winnapaug Pond, the week of August 30th, 1993. We are in full concurrence with the objectives of this preliminary field inspection, and have no objection this activity conducted within our jurisdiction. If we can be of assistance in any way, please feel free to contact us here in Wakefield.

Sincerely,

Grover J. Fugate, Executive Director
Coastal Resources Management Council

GJF/dld

August 13, 1993

Planning Directorate
Impact Analysis Division

Mr. Thomas Bigford
NOAA - Fisheries
One Blackburn Drive
Gloucester, Massachusetts 01930

Dear Mr. Bigford:

The U.S. Army Corps of Engineers is conducting a reconnaissance Section 103, Beach Erosion Control study, for Misquimicut Beach in Westerly, Rhode Island. The study area includes approximately 3.25 miles of beachfront between the Weekapaug Breechway on the east and little Maschaug Pond on the west. A recommended plan may however, encompass only a portion or portions of the study area. Please find enclosed a location map.

The following alternatives will be evaluated for the study area. They include: beachfill, beachfill with dike at western project limit that will toe into high ground, beachfill with groins, beachfill with a dike (as mentioned) and groins, revetment and beachfill, revetment and beachfill with a dike, revetment and beachfill with groins, revetment and beachfill with a dike and groins, a breakwater feeder berm or an artificial reef. Winnapaug Pond, a saltwater pond located behind Misquimicut Beach, is a potential source for beachfill material. Additional sources of beachfill will also be investigated.

A site visit is scheduled for September 1, 1993 at 2:00 p.m. at the Misquimicut State Beach parking lot. A description of the proposed project will be presented. This will provide an opportunity for comment and exchange of information on the project.

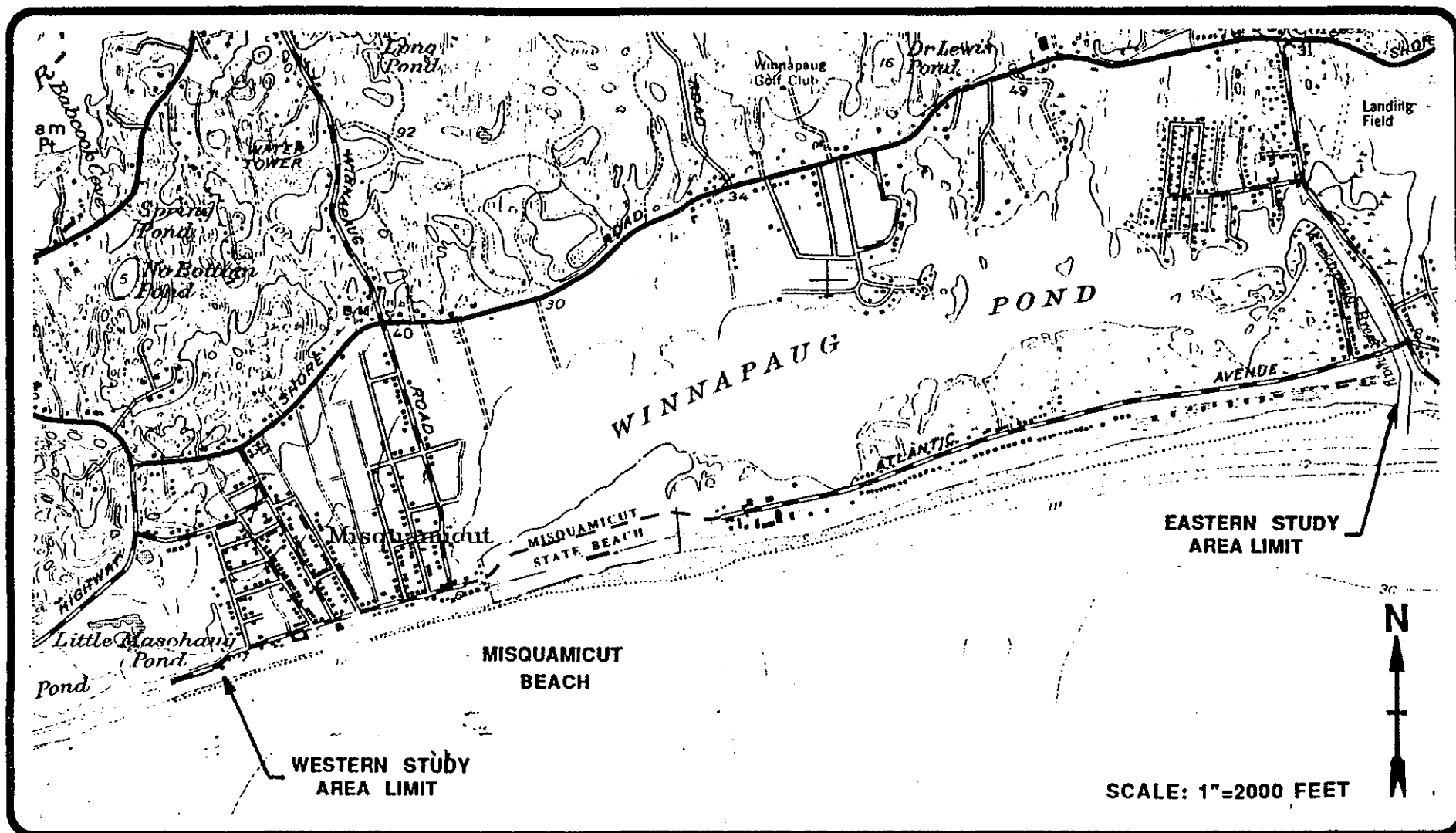
It is requested that comments on the proposed project be submitted in writing by September 7th pursuant to the Fish and Wildlife Coordination Act, as amended, and to request a list of endangered and threatened species for the project area, pursuant to the Section 7(c) of the Endangered Species Act of 1973, as amended.

Agencies unable to send a representative to the site visit should call Ms. Cathy Demos at (617) 647-8231. Any other comments or questions can also be addressed to Ms. Demos.

Sincerely,

Joseph L. Ignazio
Director of Planning

cc: Ms. Demos, Mr. Larsen, Mr. Hubbard, IAD Files



SHORE PROTECTION & EROSION CONTROL

STUDY AREA

MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND



US Army Corps
of Engineers
New England Division

August 13, 1993

Planning Directorate
Impact Analysis Division

Mr. Gordon Beckett, Supervisor
Fish and Wildlife Service
400 Ralph Pill Building
22 Bridge Street
Concord, New Hampshire 03301-4901

Dear Mr. Beckett:

The U.S. Army Corps of Engineers is conducting a reconnaissance Section 103, Beach Erosion Control study, for Misquimicut Beach in Westerly, Rhode Island. The study area includes approximately 3.25 miles of beachfront between the Weekapaug Breechway on the east and little Maschaug Pond on the west. A recommended plan may however, encompass only a portion or portions of the study area. Please find enclosed a location map.

The following alternatives will be evaluated for the study area. They include: beachfill, beachfill with dike at western project limit that will toe into high ground, beachfill with groins, beachfill with a dike (as mentioned) and groins, revetment and beachfill, revetment and beachfill with a dike, revetment and beachfill with groins, revetment and beachfill with a dike and groins, a breakwater feeder berm or an artificial reef. Winnapaug Pond, a saltwater pond located behind Misquimicut Beach, is a potential source for beachfill material. Additional sources of beachfill will also be investigated.

A site visit is scheduled for September 1, 1993 at 2:00 p.m. at the Misquimicut State Beach parking lot. A description of the proposed project will be presented. This will provide an opportunity for comment and exchange of information on the project.

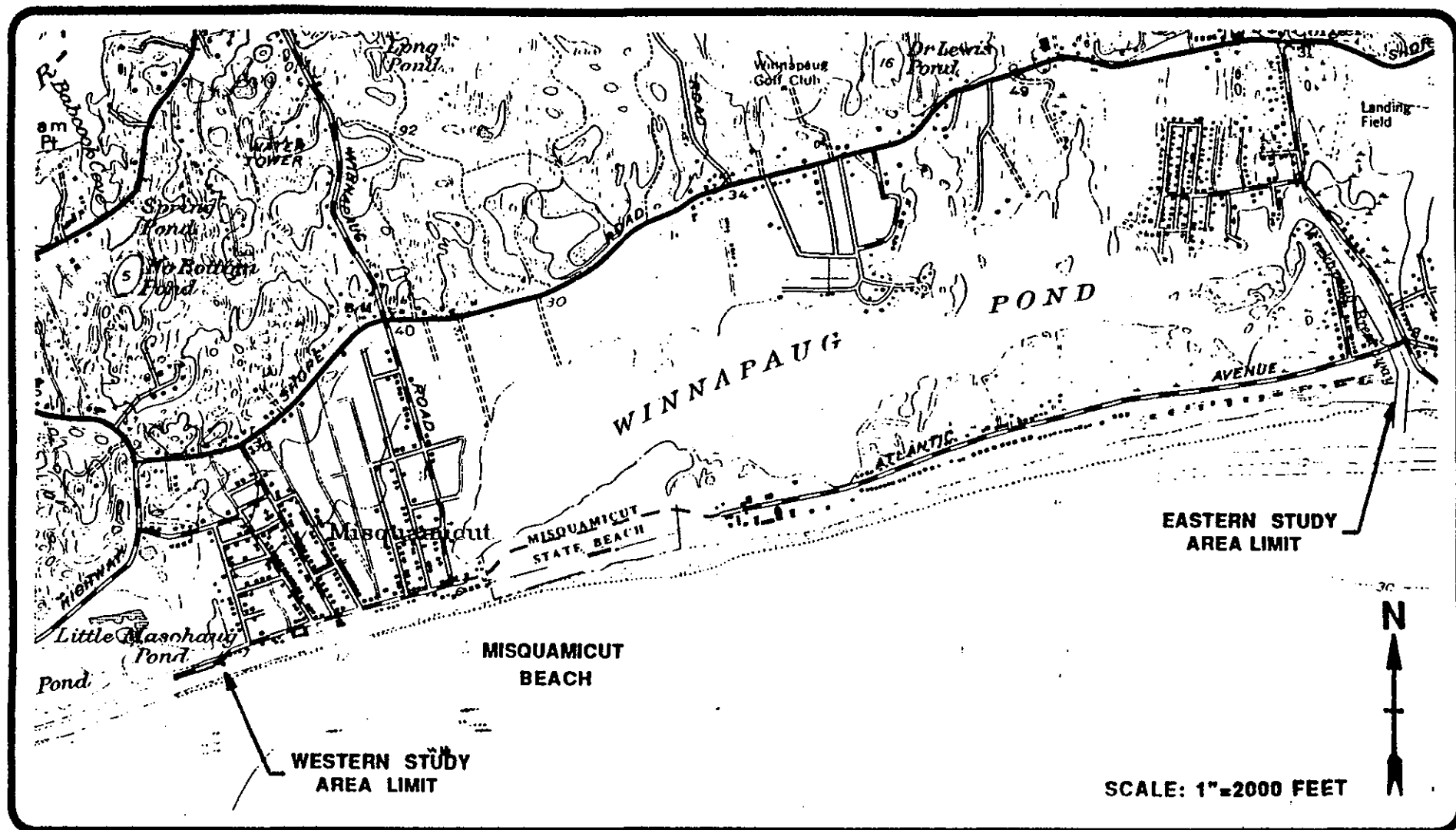
It is requested that comments on the proposed project be submitted in writing by September 7th pursuant to the Fish and Wildlife Coordination Act, as amended, and to request a list of endangered and threatened species for the project area, pursuant to the Section 7(c) of the Endangered Species Act of 1973, as amended.

Agencies unable to send a representative to the site visit should call Ms. Cathy Demos at (617) 647-8231. Any other comments or questions can also be addressed to Ms. Demos.

Sincerely,

Joseph L. Ignazio
Director of Planning

cc: Ms. Demos, Mr. Larsen, Mr. Hubbard, IAD Files



SHORE PROTECTION & EROSION CONTROL

STUDY AREA

MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND



US Army Corps
of Engineers
New England Division

August 13, 1993

Planning Directorate
Impact Analysis Division

a

Dear n :

The U.S. Army Corps of Engineers is conducting a reconnaissance Section 103, Beach Erosion Control study, for Misquimicut Beach in Westerly, Rhode Island. The study area includes approximately 3.25 miles of beachfront between the Weekapaug Breechway on the east and little Maschaug Pond on the west. A recommended plan may however, encompass only a portion or portions of the study area. Please find enclosed a location map.

The following alternatives will be evaluated for the study area. They include: beachfill, beachfill with dike at western project limit that will toe into high ground, beachfill with groins, beachfill with a dike (as mentioned) and groins, revetment and beachfill, revetment and beachfill with a dike, revetment and beachfill with groins, revetment and beachfill with a dike and groins, a breakwater feeder berm or an artificial reef. Winnapaug Pond, a saltwater pond located behind Misquimicut Beach, is a potential source for beachfill material. Additional sources of beachfill will also be investigated.

A site visit is scheduled for September 1, 1993 at 2:00 p.m. at the Misquimicut State Beach parking lot. A description of the proposed project will be presented. This will provide an opportunity for comment and exchange of information on the project.

It is requested that comments on the proposed project be submitted in writing by September 7th.

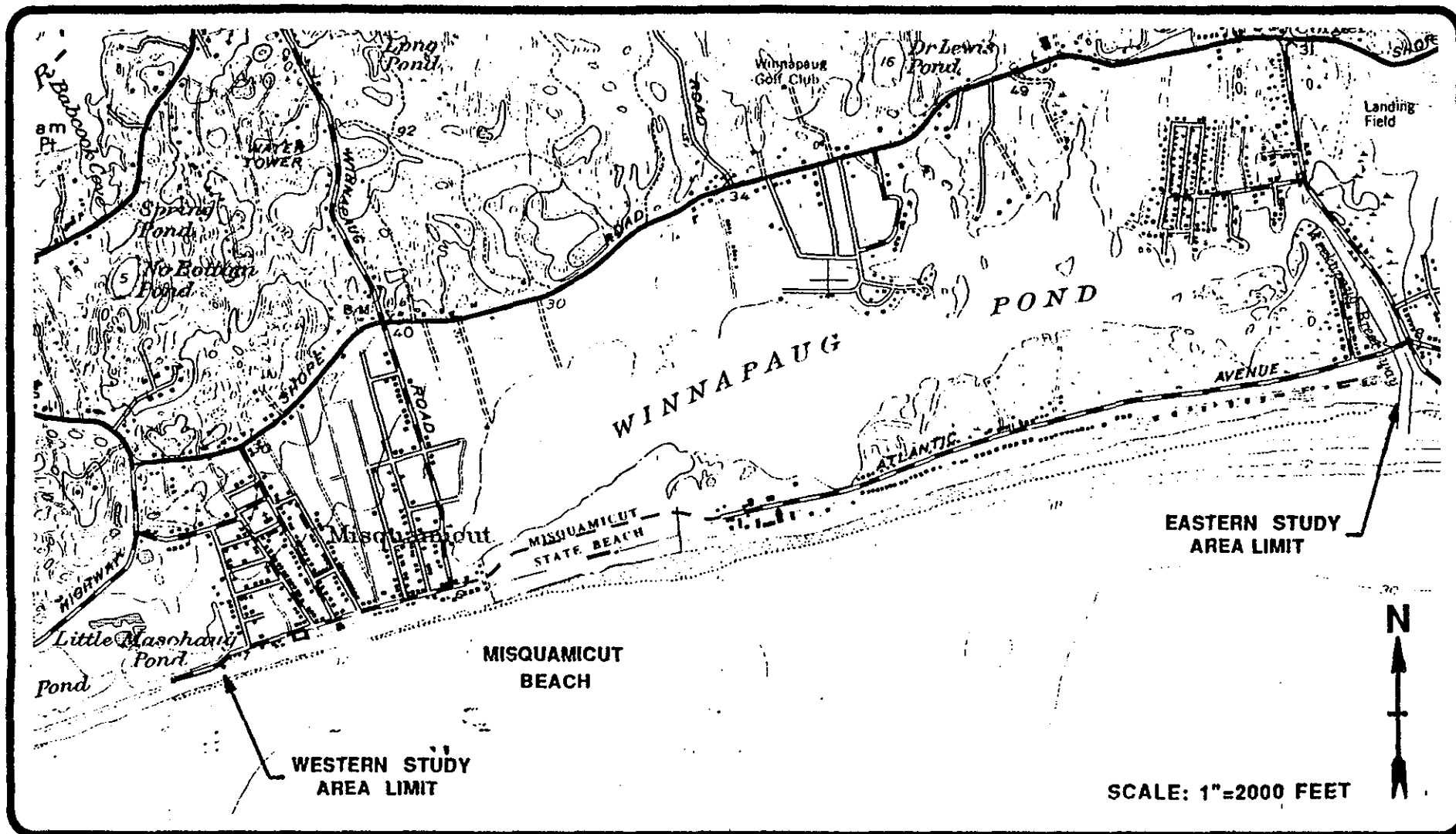
Agencies unable to send a representative to the site visit should call Ms. Cathy Demos at (617) 647-8231. Any other comments or questions can also be addressed to Ms. Demos.

Sincerely,

Joseph L. Ignazio
Director of Planning

Same letter sent to: See Attached Sheet

cc: Ms. Demos
Mr. Larsen
Mr. Hubbard
IAD Files



SHORE PROTECTION & EROSION CONTROL

STUDY AREA

MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND



US Army Corps
of Engineers
New England Division

SAME LETTER SENT TO:

Ms. Nancy Hess
Planning Zone Office
45 Broad Street
Westerly, Rhode Island 02891

Ms. Donna Giordano
Acting Town Manager
45 Broad Street
Westerly, Rhode Island 02891

Mr. Thomas Bigford
NOAA - Fisheries
One Blackburn Drive
Gloucester, Massachusetts 01930

Mr. Gordon E. Beckett, Supervisor
Fish and Wildlife Service
400 Ralph Pill Building
22 Bridge Street
Concord, New Hampshire 03301-4901

Mr. Douglas Thompson
Chief, Wetlands Protection Section
U.S. Environmental Protection Agency
J. F. Kennedy Federal Building
Boston, Massachusetts 02203-2211

Mr. Daniel Varin, Associate Director
Division of Planning
Department of Administration
One Capitol Hill
Providence, Rhode Island 02908-5870

Ms. Janet Keller
Office of Environmental Coordination
Department of Environmental Management
83 Park Street
Providence, Rhode Island 02903

Mr. Grover J. Fugate, Executive Director
Coastal Resources Management Council
Oliver H. Stedman Government Center
Tower Hill Road
Wakefield, Rhode Island 02879

Mr. Edward Szymanski, Chief,
Division of Water Resources
Department of Environmental Management
291 Promenade Street
Providence, Rhode Island 02908

Mr. James T. Beattie, Chief,
Division of Coastal Resources
Department of Environmental Management
22 Hayes Street
Providence, Rhode Island 02908

Mr. Rick Enser, Coordinator
Natural Heritage Program
Division of Planning and Development
RI Department of Environmental Management
22 Hayes Street
Providence, Rhode Island 02903

Mr. John A. Stolgitis, Chief,
Division of Fish and Wildlife
Department of Environmental Management
Government Center
4808 Tower Hill Road
Wakefield, Rhode Island 02879-22078

Bradford Fire Department
ATTN: Mr. Robert Sullivan
117 Westerly Bradford Road
Bradford, Rhode Island 02808

Dunns Corners Fire Department
ATTN: Mr. Richard Champlin
RR#3 Box 482
Dunns Corners
Westerly, Rhode Island 02891

Misquamicut Fire Department
ATTN: Peter Kaschuluk
Crandall Avenue
Westerly, Rhode Island 02891

Watch Hill Fire Department
ATTN: Carl A. Greene
Glen Way
Watch Hill, Rhode Island 02891

Westerly Fire Department
ATTN: Joseph Misto
6 Highland Avenue
Westerly, Rhode Island 02891

Weekapaug Fire Department
Wauwaloom Drive
Westerly, Rhode Island 02891

Misquamicut Businessmen's Association
c/o Thomas Quattromani
149 Atlantic Avenue
Westerly, Rhode Island 02891

Salt Pond Watchers of Rhode Island
Ellen Gorman, Executive Director
49 Surfside Avenue
Charlestown, Rhode Island 02813

Save Our Shores
c/o Carol Mitchell
10 Bayview Drive
Westerly, Rhode Island 02891

Weekapaug Beach Association
c/o Ted Nelson
Knowles Avenue
Westerly, Rhode Island 02891

Westerly Residents for Thoughtful Development
c/o Hatsy Kniffin-Moore
5 Sunset Avenue
Westerly, Rhode Island 02891



STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

Department of Administration
DIVISION OF PLANNING
One Capitol Hill
Providence, RI 02908-5870

September 3, 1993

Mr. Joseph L. Ignazio
Director of Planning
Department of the Army
New England Division
Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Ignazio:

Victor Parmentier of the Division of Planning staff attended the Corps' briefing session on the Section 103--Beach Erosion Control--study which was held at Misquamicut State Beach in Westerly, Rhode Island.

We realize that a diversity of environmental concerns need to be addressed in conjunction with the various alternatives which will be considered. Although somewhat indirectly related from the point of view of environmental concerns, as the state coordinating agency for the National Flood Insurance Program, we are interested in the impacts of this project on the floodplains in this area. The major concern of many in attendance at the session appeared to be a solution to the beach erosion problem. As I am sure you are aware, the life expectancy of any project is difficult, if not impossible, to predict. Consequently, our concern is that any structural measures undertaken could convey a false sense of security which will result in development that does not taken into consideration the possible reversion of this area to its present condition.

Thank you for providing us with the opportunity to attend the briefing session, and I would appreciate being kept apprised of the status of this project. If we can be of any assistance, please contact me at your convenience.

Yours very truly,

Daniel W. Varin
Associate Director

DWV:cac

Planning Directorate
Plan Formulation Division

7 SEP 1993

Ms. Nancy Hess
Town Planner
45 Broad Street
Westerly, Rhode Island 02891

Dear Ms. Hess:

The Corps of Engineers, at the request of the Town of Westerly, has initiated a Reconnaissance study to be conducted under Section 103 of the River and Harbor Act of 1962. The study will address storm damages, flooding and coastal erosion in the area of Misquamicut Beach.

Engineers of my staff would like to brief the Town Council of Westerly on the progress of our Reconnaissance study. Would you please arrange a meeting with the council in September that will allow them the opportunity to do so? If you have any questions, please contact the study manager, Mr. David Larsen, at (617) 647-8113.

Sincerely,

Brink P. Miller
Colonel, Corps of Engineers
Division Engineer

cc:

Mr. Larsen, 114S
Mr. Smith, 114S
Mr. Pronovost, 114N
Plng. Dir. Files, 114N
XO, 100
Reading
CDB Files, 114S



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Habitat & Protected
Resources Division
Milford Laboratory
Milford, Connecticut 06460-6499

September 10, 1993

Mr. Joseph L. Ignazio
Director of Planning
New England Division
Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

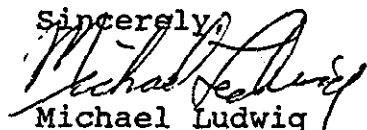
Dear Mr. Ignazio:

We have reviewed the information regarding the Beach Erosion Control Study for Misquimicut Beach at Westerly, Rhode Island. The use of Winnapaug Pond as a source of beach material, the nature of the activities proposed for the ocean face erosion control and the probable presence of leatherback sea turtles (Dermochelys coriacea) protected under the Endangered Species Act (ESA) are all issues of concern to the National Marine Fisheries Service. Additionally, the use of a dike in the mix of potential options for beach erosion control requires explanation.

The endangered leatherback sea turtle occupies coastal waters of Rhode Island during the summer months, foraging for jellyfish. Its presence in the project area engenders assessment under Section 7 of ESA.

Should you wish to discuss this matter please contact Colleen Coogan at (508) 281-9291 or me at (203) 783-4200.

Sincerely,


Michael Ludwig
Fishery Biologist





United States Department of the Interior

FISH AND WILDLIFE SERVICE

New England Field Offices
400 Ralph Pill Marketplace
22 Bridge Street, Unit #1
Concord, New Hampshire 03301-4901

Joseph L. Ignazio
Planning Directorate
Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

September 10, 1993

ATTN: Impact Analysis Division

Dear Mr. Ignazio:

This responds to your letter dated August 13, 1993 requesting information on the presence of Federally listed and proposed endangered or threatened species in relation to the proposed reconnaissance Section 103, Beach Erosion Control study for Misquimicut Beach in Westerly, Rhode Island. The following comments are also provided in accordance with the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The most significant natural resource in this area is Winnapaug Pond. This area provides important habitat for many species of coastal fish and wildlife. It has been identified as winter flounder spawning and wintering habitat, fall and spring migratory waterfowl and shorebird habitat, and is the northern limit for Gadwall (*Anas strepera*).

Based on information currently available to us, the Federally listed threatened Atlantic coast piping plover (*Charadrius melodus*) is known to nest on the outer beach of Maschaug Pond and Little Maschaug Pond, at the western end of the study area. No other Federally listed or proposed threatened and endangered species under the jurisdiction of the U.S. Fish and Wildlife Service are known to occur in the project area, with the exception of occasional transient endangered bald eagles (*Haliaeetus leucocephalus*) or peregrine falcons (*Falco peregrinus anatum*). However, a candidate Category 2¹ and State listed endangered plant, the Northern blazing star, is found in the proposed project area. The seaside sparrow (*Ammodramos maritima*), a State Species of Concern, is known to breed in this area. We suggest that you contact Chris Raithel, Division of Fish and Wildlife, Box 218, W. Kingston, RI 02892, 401-789-0281 for information on the piping plover and Rick Enser of the Rhode Island Natural Heritage Program at 83 Park St., Providence, RI 02903, telephone 401/277-2776, for information on state listed species that may be present.

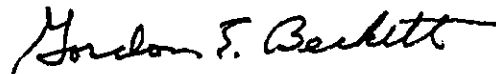
¹ Information is available which indicates that proposing to list as endangered or threatened is possibly appropriate but for which conclusive data are not currently available to support proposed rules.

It is unclear from the information provided in the letter what specific alternatives will be recommended. Without more detailed information, it is not possible to determine the impacts to fish and wildlife resources from this project. The study should evaluate a full spectrum of alternatives for the project and provide an extensive discussion of the various alternatives and their environmental impacts. In most cases, the Service favors nonstructural versus structural alternatives. Dredging in the Winnapaug Pond should be avoided, unless it can be shown to improve or restore habitat. The Service will make more detailed comments upon receiving a copy of the reconnaissance Section 103, Beach Erosion Control Study.

Changes to the beach fronting Maschaug Pond or Little Maschaug Pond resulting from any of the proposed alternatives may adversely affect nesting piping plover habitat. Alternatives including the construction of groins and dikes should carefully consider how these structures impact nearby beaches.

A list of Federally designated endangered and threatened species in Rhode Island is included for your information. Thank you for your cooperation and please contact Susi von Oettingen of this office on endangered species issues at (603) 225-1411; on issues concerning the Fish and Wildlife Coordination Act, please contact Gregory Mannesto of our Rhode Island Field Office at 401-364-9124.

Sincerely yours,



Gordon E. Beckett
Supervisor
New England Field Offices

Inclosure

FEDERALLY LISTED ENDANGERED AND THREATENED SPECIES
IN RHODE ISLAND

<u>Common Name</u>	<u>Scientific Name</u>	<u>Status</u>	<u>Distribution</u>
FISHES:			
Sturgeon, shortnose*	<u>Acipenser brevirostrum</u>	E	Atlantic coastal waters and rivers
REPTILES:			
Turtle, green*	<u>Chelonia mydas</u>	T	Oceanic straggler in southern New England
Turtle, hawksbill*	<u>Eretmochelys imbricata</u>	E	Oceanic straggler in southern New England
Turtle, leatherback*	<u>Dermochelys coriacea</u>	E	Oceanic summer resident
Turtle, loggerhead*	<u>Caretta caretta</u>	T	Oceanic summer resident
Turtle, Atlantic ridley*	<u>Lepidochelys kempii</u>	E	Oceanic summer resident
BIRDS:			
Eagle, bald	<u>Haliaeetus leucocephalus</u>	E	Entire state, occasional
Falcon, American peregrine	<u>Falco peregrinus anatum</u>	E	No current nesting; entire state-migratory
Falcon, Arctic peregrine	<u>Falco peregrinus tundrius</u>	T	No nesting; entire state-migratory
Plover, Piping	<u>Charadrius melodus</u>	T	Atlantic coast, Washington and Newport Counties
Roseate Tern	<u>Sterna dougallii dougallii</u>	E	Atlantic coast
MAMMALS:			
Whale, blue*	<u>Balaenoptera musculus</u>	E	Oceanic
Whale, finback*	<u>Balaenoptera physalus</u>	E	Oceanic
Whale, humpback*	<u>Megaptera novaeangliae</u>	E	Oceanic
Whale, right*	<u>Eubalaena</u> spp. (all species)	E	Oceanic
Whale, sei*	<u>Balaenoptera borealis</u>	E	Oceanic
Whale, sperm*	<u>Physeter catodon</u>	E	Oceanic
MOLLUSKS:			
NONE			
INSECTS:			
Beetle, American burying	<u>Nicrophorus americanus</u>	E	Washington
Beetle, northeastern beach tiger	<u>Cicindela dorsalis dorsalis</u>	T	Washington, probably extirpated
Beetle, Puritan tiger	<u>Cicindela puritana</u>	T	Extirpated
PLANTS:			
Small Whorled Pogonia	<u>Isotria medeoloides</u>	E	Providence, Kent Counties
Gerardia, Sandplain	<u>Agalinus acuta</u>	E	Washington

* Except for sea turtle nesting habitat, principal responsibility for these species is vested with the National Marine Fisheries Service



STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

COASTAL RESOURCES MANAGEMENT COUNCIL

Oliver H. Stedman Government Center
4808 Tower Hill Road
Wakefield, R.I. 02879-1900
(401) 277-2476

Department of the Army
New England Division, Corps of Engineers
Mr. Joseph Ignazio, Director of Planning
Impact Analysis Division
424 Trapelo Road
Waltham, MA 02254-9149

September 10, 1993

Dear Mr. Ignazio:

The Coastal Resources Management Council (CRMC) appreciated the invitation to the Army Corps preliminary assessment meeting for Misquamicutt Beach, on September the 1, 1993. At this time, it would appear that a number of projects are under consideration by the Corps. We realize that both flooding and storm damage concerns need to be addressed, but as managers of the State's coastal resources, we have concerns regarding how this is approached.

First, let me say that coordination with the Town of Westerly is imperative for the rectification of the flooding problems. Currently, the town drainage system collects the water that pools in the low-lying neighborhood at the western end of the study area, and channels it towards Winnapaug Pond. Clogging and insufficient operation of this system, coupled by the storm overwash and heavy rains, caused the Town to conduct unpermitted work to alleviate the flooding situation. As a result, the Town is currently under a consent agreement with the CRMC, to provide a new drainage design for an ocean outfall, that will ultimately replace the outdated, and overloaded pond discharge system. This outfall system may involve pumping stations, and redirection of flow to the western end of Atlantic Avenue. Any efforts by the Corps to improve flooding and drainage would not work in isolation from the existing plans of the Town of Westerly. In addition, the proposed dike system at the western end of the study area should also be designed and considered in conjunction with the Town's drainage project, to ensure that the project accomplishes the goal of rectifying flooding and drainage inadequacies. The dike would most likely need to tie in to the dune or shore at or near where an ocean outfall pipe might be.

For your information, the golf course that lies just north of Little Mashaug Pond, is also attempting to correct flooding problems of its own, and is expected to propose some sort of project shortly. Should a dike be considered an appropriate solution to halt the storm washover that enters into this neighborhood through Little Mashaug Pond, the CRMC will review the construction details at the appropriate time.

Massive beachfill is our preferred option for the length of Misquamicutt Beach, so that the barrier beach can retain its natural appearance and function. In fact, under our current policies, structural shoreline protection is prohibited. Therefore, unless strong justification can be provided for the selection of revetments, seawalls, riprap, or any other hardened structure along the length of the beachface, it is strongly discouraged at this time. The merit of placing a series of groins or jetties is also strongly questioned, due to the decreased recreational effects, and the potential to damage other beach areas along the South Shore, such as Green Hill and Matunick Beach, which can ill afford sand loss. We are of the opinion that beachfill is needed to widen the beachface, and to raise the height of the overall beach profile. However, we will require that where such a project benefits private property, a public access easement or right-of-way agreement is stipulated as a condition of the project. This will be a high priority for CRMC and the State as we review the public benefits and merits of this project.

The CRMC is not in opposition to the use of Winnapaug Pond as a sediment source. In addition to the sediment sampling of the pond, I suggest you review the material Art Ganz, Senior Shellfish Biologist, has provided. If a habitat restoration project for the pond can be coordinated with Corps removal of sediment, the CRMC would encourage and assist these efforts. The local Salt Ponds Coalition, The Sounds Conservancy, and RI Department of Environmental Management's Division of Fish, Wildlife, and Estuarine Resources, may all assist towards this end.

I appreciate the opportunity to comment on some of the potential methods to facilitate this project. Let me assure you that the CRMC will assist you in any way possible, as this study, and hopefully this project, proceeds. If you have any questions regarding our comments, please call me, or Donna Doyle, at 401-277-2476.

Sincerely,



Grover J. Fugate, Executive Director
Coastal Resources Management Council



STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

COASTAL RESOURCES MANAGEMENT COUNCIL

Oliver H. Stedman Government Center
4808 Tower Hill Road
Wakefield, R.I. 02879-1900
(401) 277-2476

September 13, 1993

Mr. Joseph Ignazio, Director
Planning Directorate
Army Corps of Engineers New England Division
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Ignazio;

You and appropriate members of your staff are cordially invited to a small informational meeting on September 24th at 10 a.m. in the Challenger Room at the Bay Campus's Pell Library, to assist the Army Corps of Engineers in their reconnaissance study on Misquamicut. The Coastal Resources Management Council is organizing this informational meeting to increase the flow of input from individuals and organizations who can assist the Army Corps in the early decision-making stages of this project. The reconnaissance study is evaluating the drainage, flooding, erosion, and storm damage problems that occur along Atlantic Avenue. Please bring any pertinent information with you, be prompt, and come ready to comment. Thank you in advance for your interest and participation.

Sincerely,

Grover J. Fugate, Executive Director
Coastal Resources Management Council

GJF/dld



Town of Westerly, R. I.

CONSERVATION COMMISSION

September 21, 1993

Mr. Joseph L. Ignazio
Director of Planning
Department of the Army
New England Division Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02254-9149

Dear Mr. Ignazio:

This letter is in response to the request for comments regarding the proposed project for beach erosion control at Misquamicut Beach in Westerly, Rhode Island. The comments below were developed at the regular monthly meeting of the Westerly Conservation Commission, September 21st. Although the comments were requested by September 7th in your letter to various agencies (August 31, 1993), Ms. Cathy Demos verbally extended this date (ASAP) at the September 1st meeting at Misquamicut.

At this time we can not be very specific on each of the alternatives being evaluated due to their lack of detail. The following information, concerns, questions, etc. are offered so that the process will not overlook items we feel are important.

1. Limited reconstruction of the beach may be beneficial using dredged material from the adjacent pond as long as contaminants that may be in place are not released to the environment.
2. Any tidal gates installed at the breachway should not interfere with existing boating and recreational fishing and should not create adverse effects on the pond's fishery.
3. In general the RI CRMC prohibits the installation of hard structure for good reason. In your evaluation of the use of these types of structures, the effects of deflected energy to areas adjacent to the study area should be considered.
4. Some of the hard structure proposed would limit and even eliminate lateral access along the beach front that the public currently enjoys and is granted by law. To take away this privilege is to significantly reduce the quality of life of persons using this prime natural resource.



Town of Westerly, R. I.

CONSERVATION COMMISSION

Page 2

5. The dike mentioned at the western extremity again should not limit public access that currently exists.
6. The project engineer, Dave Larson, discussed plans to widen the beach. To what extent is unknown. We are aware that there is a natural rock reef parallel to shore a short distance offshore (100 yards \pm). This reef likely harbors marine life which in turn attracts gamefish helping to make this area a prime recreational fishing area.
7. The artificial reef concept seems risky and unproved for this location. The public travels to this area to enjoy the natural wave action for swimming, surfing, boogie boarding and surf boarding. These activities may be curtailed thereby adversely affecting the public's enjoyment and businesses relying on their patronage.

The undersigned and two other commission members attended the September 1st briefing. It was apparent the Corps' personnel were not familiar with the area and did not have all the information needed to factor in all the public's needs and concerns. It is disturbing to find your study in following federal guidelines does not account for recreational values. We feel this is very important to the town's quality of life as well as impacts to the local economy. The public using this beach area supports various businesses, e.g. fisher persons support tackle/bait businesses, motels, restaurants, stores, gasoline stations, etc. This should be factored into your cost/benefit ratio.

We are ready to assist the effort to properly protect this natural resource. Please utilize the considerable knowledge that exists with our Conservation Commission members. We look forward to working with you.

Very truly yours,

Joseph H. Dawson
Chairman,
Westerly Conservation Commission

c/o Westerly Town Hall
45 Broad Street
Westerly, R.I. 02891

xc: Town Council, Attn: R. Comolli, Chairman
Town Manager



UNIVERSITY OF
RHODE ISLAND

Email: grilli@mistral.oce.uri.edu
tel.: (401) 792-6636

September 29, 1993

Mr. David Larsen
US Army Corps of Engineers
New England Division
424 Trapelo Rd.
Waltham, MA 02254-9149

Dear Mr. Larsen :

It was a pleasure meeting you and your colleagues at URI last Friday.

The problem of protecting the Misquamicut area from further beach erosion and flooding is a very challenging one. As it is always the case in coastal engineering, no simple standard solution can be readily applied but a site specific combination of protection and mitigation methods must be designed, considering many technical, environmental, and economical constraints.

As Dr. Spaulding and I mentioned it during the meeting, the Ocean Engineering Department has considerable combined expertise in the areas of work required for the project. In the very important aspects of environmental forcing from ocean waves, and tidal and wind driven currents, we can set up existing hydrodynamic models for the area and gather and analyze field data for model calibration. We can also study, through modeling, theories, and field measurements (in collaboration with J. Boothroyd from the Geology Department), important aspects of sediment transport and beach erosion in connection with the beach fill and renourishment projects. Structural solutions can also be studied and their impact simulated in the models. Finally, the department has a world class Marine Geomechanics Laboratory, under the direction of Dr. A. Silva, whose expertise can help for both field coring and dredging studies, and for studying geotechnical aspects of structural solutions.

As we discussed after the meeting, the Ocean Engineering Department is very interested in taking an active part in this project. Funds from the State of Rhode Island or from other

sources in the State could probably be obtained to support OE's involvement in the project, which could thus give a further incentive and justification for the Corps to get involved.

We are looking forward to hearing more from you about the development of this project.

Sincerely,

A handwritten signature in black ink, appearing to be 'Stéphan Grilli', with a large, stylized 'S' and 'G'.

Stéphan Grilli
Associate Professor

cc: J. Boothroyd, Geology; V. Lee, CRC; M.L. Spaulding and A. Silva, OE



UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
NORTHEAST REGION
One Blackburn Drive
Gloucester, MA 01930

OCT 12 1993

Mr. Joseph L. Ignazio
Director of Planning
New England Division
Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Ignazio:

In response to discussions with Ms. Demos of your staff, Ms. Colleen Coogan, of my staff, has reviewed the Beach Erosion Control Study for Misquimicut Beach in Westerly, Rhode Island. We have determined that, dependant on final plans, the project is not likely to adversely affect endangered or threatened species that may be present in the project area. Further consultation pursuant to Section 7 of the Endangered Species Act may be necessary, however, if the results of further study identifies sand from offshore borrow areas as the preferred source for beach fill material. Use of hopper dredges during warm water periods (June through November) may lethally take sea turtles that seasonally occur in Block Island Sound, offshore of Misquimicut Beach.

Notification of the potential occurrence of the endangered leatherback sea turtle (Dermochelys coriacea) in the project area was forwarded to you by our Milford, Connecticut staff in a letter dated September 10, 1993. Additional listed species that may transit through the Block Island Sound during summer months include endangered Kemp's ridley (Lepidochelys kemp), green (Chelonia mydas), and threatened loggerhead (Caretta caretta) sea turtles. These turtles are benthic feeders and are especially susceptible to the hopper dredge's quick moving dredge head. Leatherbacks, which forage primarily on jellyfish throughout the water column, are not often adversely affected by hopper dredges.

Alternatives evaluated in the study, according to your August 13, 1993 letter, include acquisition of sand from a saltwater pond behind the beach as well as construction of a revetment, groin, dike, and/or breakwater. These activities are not likely to adversely affect leatherbacks or any other listed species of sea turtles.

Ms. Demos has indicated that preliminary study results show the saltwater pond may not be a suitable source for beach fill material, therefore, offshore borrow areas may be considered as alternate sources. As discussed above and in the attached report from the Waterways Experiment Station, hopper dredges deployed in

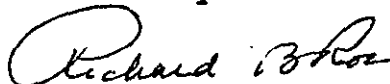


areas where sea turtles occur can lethally take turtles by entrainment in the draghead. If a hopper dredge is to be used in Block Island Sound between June and November, a formal Section 7 consultation would be required. Use of a clamshell dredge during that period, or dredging from December through May would preclude adverse affects to listed species and eliminate the need for a formal consultation pursuant to Section 7 of the Endangered Species Act.

In addition to our responsibilities under the Endangered Species Act, NMFS is concerned about affects to all living marine resources. Our Habitat Conservation staff has expressed a need for additional information regarding the specific actions being considered, especially the possibility of dike construction. The potential for affecting wetlands and submerged aquatic vegetation in areas such as Little Maschaug Pond are of particular concern. As a result of these concerns, we would appreciate continued updates on the recommendations resulting from the on-going Beach Erosion Control study at Misquimicut Beach.

In summary, if final project plans do not include dredging of borrow areas in the Block Island Sound by hopper dredge in warm water months (June through November), the Misquimicut Beach Erosion project is not likely to adversely affect listed species and no further consultation is needed pursuant to Section 7 of the Endangered Species Act. However, review of the results of the Misquimicut study may result in additional recommendations from NMFS staff regarding other living marine resources. Please call Colleen Coogan (508 281-9291) if you have any questions regarding the ESA consultation process, or Michael Ludwig (203 783-4200) for discussion regarding impacts to living marine resources.

Sincerely

A handwritten signature in dark ink, appearing to read "Richard B. Roe", written in a cursive style.

Richard B. Roe
Regional Director

Attachment

cc: Ludwig
Demos, COE

October 28, 1993

Planning Directorate
Impact Analysis Division

Edward F. Sanderson - Executive Director
Rhode Island Historic Preservation Commission
150 Benefit Street
Providence, Rhode Island 02903

Dear Mr. Sanderson:

The U.S. Army Corps of Engineers, New England Division, is conducting a Reconnaissance Investigation for a Section 103 Beach Erosion Control Study at Misquamicut Beach in Westerly, Rhode Island (see Study Area map). The study area includes approximately 3.25 miles of beachfront between the Weekapaug Breachway on the east and Little Maschaug Pond on the west. We are providing this information as background in the event this project proceeds to a further stage of planning and would appreciate your initial comments.

The area of Misquamicut Beach between Winnapaug and Little Maschaug Ponds and between the Shore Road and the beach has been subject to periodic coastal flooding from Long Island Sound by way of Little Maschaug Pond on the west and the Weekapaug Breachway on the east. The following alternatives have been proposed: (i) the raising of homes affected by the flooding; (ii) placing a wall or dike east of Little Maschaug Pond together with a wall or dike west of Winnapaug Pond, (iii) the combination of the wall or dike east of Little Maschaug Pond with a tide gate structure at the Weekapaug Breach. Each of these alternatives would be combined with the placement of beachfill along Misquamicut Beach. Winnapaug Pond, a saltwater pond located behind Misquamicut Beach, is a potential source for beachfill material. Additional sources of beachfill, both offshore and upland are also being investigated.

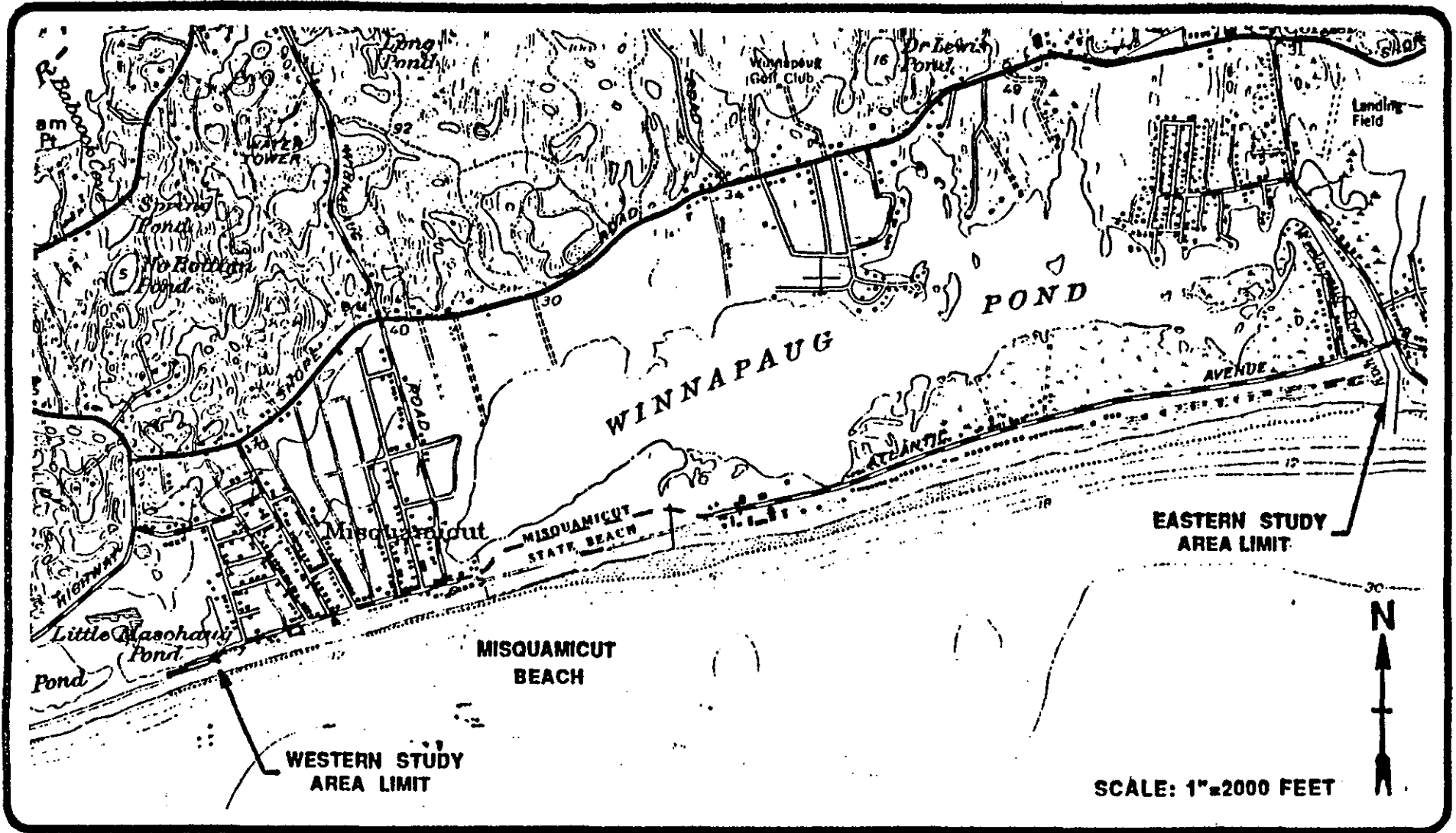
A check of the Historical Resources of Westerly, Rhode Island provided by your office indicates that the Misquamicut Historic District is located within the proposed project area. This district is a summer resort composed of primarily small early to mid-20th Century summer cottages in a densely populated area between the Shore Road and Block Island Sound and at the west end of Winnapaug Pond (Rhode Island Historical Preservation Commission 1978:29). The raising of homes in this area could affect significant historic resources. However, the exact number of homes affected and subject to raising has yet to be determined. We feel that the other proposed non-structural (beachfill) and structural alternatives (wall, dike, or gate structure) should have no effect upon any structures that make up this historic district or any other cultural resources in the area as their placement would be limited to previously disturbed areas. Sources for beachfill, when selected, would have to be evaluated for historic or archaeological potential.

This is a preliminary investigation. If this project proceeds to a further stage in the planning process, then a detailed plan will be selected. At that time, the final plan will be evaluated for its effect upon historic properties and we will request your formal comments to satisfy Section 106 of the National Historic Preservation Act of 1966, as amended. If you have any questions, please contact Mr. Marc Paiva, Project Archaeologist, of the Impact Analysis Division at (617) 647-8796.

Sincerely,

Joseph L. Ignazio
Director of Planning

Enclosure



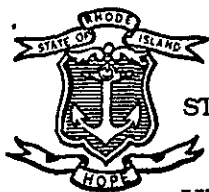
SHORE PROTECTION & EROSION CONTROL

STUDY AREA

MISQUAMICUT BEACH, WESTERLY, RHODE ISLAND



US Army Corps
of Engineers
New England Division



STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

HISTORICAL PRESERVATION COMMISSION

Old State House
150 Benefit Street
Providence, Rhode Island 02903
401-277-2678 • FAX 401-277-2968 • TDD 401-277-3700

November 17, 1993

Mr. Joseph L. Ignazio
Director of Planning
Impact Analysis Division
New England Division
U. S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Re: Misquamicut Beach Erosion Control Study
Westerly

Dear Mr. Ignazio:

The Rhode Island Historical Preservation Commission has received and reviewed the information you have provided our staff on the above-referenced project. Based upon a cross-reference between the information you have provided and our files, we note one historic resource that has not been previously mentioned, the Weekapaug Bridge. This stone-faced concrete bridge over the Weekapaug Breachway has been determined eligible for listing on the National Register Historic District.

The other known resource which you cite, the Misquamicut Historic District, has received only a preliminary assessment to date. More work would be needed to determine its National Register eligibility.

With regard to the possible excavation of beachfill, we agree that source areas for such fill would need to be evaluated for historic and archaeological potential if that alternative is pursued.

In our preliminary consideration on the project, we find that there is to date insufficient information on affected resources or project alternatives to form opinions on the possible effects. We will need to consult further with you as the project develops in order to make informed determinations.



Mr. Joseph L. Ignazio

2

November 17, 1993

These comments are provided in accordance with Section 106 of the National Historic Preservation Act. If you have any questions or comments, please contact Richard E. Greenwood, Project Review Coordinator for this office.

Very truly yours,



Edward F. Sanderson
Executive Director
Deputy State Historic
Preservation Officer

{5:37}



STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

Department of Environmental Management
DIVISION OF WATER RESOURCES

291 Promenade Street
Providence, R.I. 02908 - 5767
(401) 277-3961

December 22, 1993

Mr. Joseph L. Ignazio, Director of Planning
Impact Analysis Division
U.S. Army Corps of Engineers
424 Trapelo Road
Waltham, MA 02254-9149

Dear Mr. Ignazio:

I am writing in response to your letter to Louise Durfee dated October 18, 1993 concerning Army Corps of Engineers' (ACOE) study of flood protection along Misquamicut Beach in Westerly, Rhode Island. As you are aware, the Division of Water Resources has been involved in several meetings with the ACOE, Westerly officials and other permitting agencies relating to the study. Due to comments made at these meetings, the ACOE has raised concerns pertaining to Rhode Island's position on the ability to issue a water quality certification for a project which includes fill of waters/wetlands of the State.

As a general rule, projects which include fill of waters of the state are rarely approved since they would constitute a permanent loss of existing uses, such as a fish and wildlife habitat. However, there have been projects where limited fill materials have received water quality certification with the approval of other appropriate agencies.

I encourage ACOE to fully pursue those alternatives that minimize impact to water quality and existing uses. My staff would be happy to discuss specific alternatives in detail with the ACOE. If you have any further questions or wish to meet to discuss this project, please do not hesitate to contact me at (401)277-3961 or Carlene Newman at (401)277-6519.

Sincerely,

Alicia M. Good, P.E., Chief
Division of Water Resources
Department of Environmental Management

AMG/CBN

cc: Louise Durfee, Director